International® MaxxForce® 11 and 13 Diesel Engines

For
2008 through 2009 Model Year
Truck and Derivative Vehicle Applications

Engine Operation and Maintenance Manual

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Foreword

Navistar, Inc. is committed to continuous research and development to improve products and introduce technological advances. Procedures, specifications, and parts defined in published technical service literature may be altered.

NOTE: Photo illustrations identify specific parts or assemblies that support text and procedures; other areas in a photo illustration may not be exact.

This manual includes necessary information and specifications for operators to service Navistar diesel engines. Contact an International® dealer for more information.

Technical Service Literature

1171898R5	International® MaxxForce® 11 and 13 *Engine Operation and Maintenance Manual*
EGES-415-1	International® MaxxForce® 11 and 13 *Engine Service Manual*
EGES-420–1	International® MaxxForce® 11 and 13 *Engine Diagnostic Manual*
EGED-425	International® MaxxForce® 11 and 13 Engine Diagnostic Form
EGED-430–2	International® MaxxForce® 11 and 13 Engine Wiring Diagram
EGED-435	International® MaxxForce® 11 and 13 Signal Values (available on ISIS® only)

Technical service literature is revised periodically and mailed automatically to “Revision Service” subscribers. If a technical publication is ordered, the latest revision will be supplied.

To order technical service literature, contact your International® dealer.

All marks are trademarks of their respective owners.

Safety Information

This manual provides general and specific maintenance procedures essential for reliable engine operation and your safety. Since many variations in procedures, tools, and service parts are involved, advice for all possible safety conditions and hazards cannot be stated.

Read safety instructions before doing any service and test procedures for the engine or vehicle. See related application manuals for more information.

Obey Safety Instructions, Warnings, Cautions, and Notes in this manual. Not following warnings, cautions, and notes can lead to injury, death or damage to the engine or vehicle.

Safety Terminology

Three terms are used to stress your safety and safe operation of the engine: Warning, Caution, and Note

Warning: A warning describes actions necessary to prevent or eliminate conditions, hazards, and unsafe practices that can cause personal injury or death.

Caution: A caution describes actions necessary to prevent or eliminate conditions that can cause damage to the engine or vehicle.

Note: A note describes actions necessary for correct, efficient engine operation.

Safety Instructions

Work Area

- Keep work area clean, dry, and organized.
- Keep tools and parts off the floor.
- Make sure the work area is ventilated and well lit.
- Make sure a First Aid Kit is available.

Safety Equipment

- Use correct lifting devices.
- Use safety blocks and stands.

Protective Measures

- Wear protective safety glasses and shoes.
- Wear correct hearing protection.
- Wear cotton work clothing.
- Wear sleeved heat protective gloves.
- Do not wear rings, watches or other jewelry.
- Restrain long hair.

Vehicle

- Shift transmission to park or neutral, set parking brake, and block wheels before doing diagnostic or service procedures.

- Clear the area before starting the engine.

Engine

- The engine should be operated or serviced only by qualified individuals.
- Provide necessary ventilation when operating engine in a closed area.
- Keep combustible material away from engine exhaust system and exhaust manifolds.
- Install all shields, guards, and access covers before operating engine.
- Do not run engine with unprotected air inlets or exhaust openings. If unavoidable for service reasons, put protective screens over all openings before servicing engine.
- Shut engine off and relieve all pressure in the system before removing panels, housing covers, and caps.
- If an engine is not safe to operate, tag the engine and ignition key.

Fire Prevention

- Make sure charged fire extinguishers are in the work area.

NOTE: Check the classification of each fire extinguisher to ensure that the following fire types can be extinguished.

1. Type A — Wood, paper, textiles, and rubbish
2. Type B — Flammable liquids
3. Type C — Electrical equipment

Batteries

- Always disconnect the main negative battery cable first.
- Always connect the main negative battery cable last.
- Avoid leaning over batteries.
- Protect your eyes.
- Do not expose batteries to flames or sparks.
- Do not smoke in workplace.

Compressed Air

- Use an OSHA approved blow gun rated at 207 kPa (30 psi).
- Limit shop air pressure to 207 kPa (30 psi).
- Wear safety glasses or goggles.
- Wear hearing protection.
- Use shielding to protect others in the work area.
- Do not direct compressed air at body or clothing.

Tools

- Make sure all tools are in good condition.
- Make sure all standard electrical tools are grounded.

- Check for frayed power cords before using power tools.

Fluids Under Pressure

- Use extreme caution when working on systems under pressure.
- Follow approved procedures only.

Fuel

- Do not over fill the fuel tank. Over fill creates a fire hazard.
- Do not smoke in the work area.
- Do not refuel the tank when the engine is running.

Removal of Tools, Parts, and Equipment

- Reinstall all safety guards, shields, and covers after servicing the engine.
- Make sure all tools, parts, and service equipment are removed from the engine and vehicle after all work is done.

Warranty

Federal Emission System Warranty

WARRANTY PERIOD

Navistar Inc. warrants your heavy-heavy duty diesel engine for the following warranty period (whichever comes first):

- 5 years
- 160,000 km (100,000 miles)
- Or if covered by any basic or extended warranty (if greater than above)

Your heavy-heavy duty diesel engine conforms to U.S. Environmental Protection Agency (EPA) regulations for emission systems.

The engine model year, service class, and required emission information is on the emission label on top of the high pressure charge air cooler. This warranty is based on the engine model year, not the model year of the vehicle. The warranty period begins on the date the new vehicle is delivered to the first retail purchaser.

REQUIRED MAINTENANCE

As the vehicle owner, you are responsible for all required maintenance described in this manual. Navistar recommends that you retain all maintenance receipts. Navistar will not deny an emission warranty claim solely because you have no record of maintenance. However, a claim may be denied if your failure to perform proper maintenance resulted in the failure of a warranted part and you cannot provide appropriate evidence of maintenance. Take your vehicle to an International® dealer when a problem occurs.

WARRANTY REPAIRS AND SERVICE

All emission control system parts proven defective during normal use will be repaired or replaced during the warranty period. Warranty repairs and service will be done by any authorized International® dealer with no charge for parts, labor and diagnostics. Warranty repairs should be completed in a reasonable time, not to exceed 30 days. Navistar may deny you warranty coverage if your vehicle or a part has failed due to abuse, neglect, improper maintenance or unapproved modifications.

RECOMMENDED MAINTENANCE OR REPAIR PARTS

International® service parts or International® ReNEWed™ parts are recommended for maintenance or repairs to maintain the original quality of your emission certified engine. If parts not recommended by Navistar cause damage to the engine or vehicle, the warranty is invalid and maintenance and repair costs will not be covered.

Federal Emission System Warranty (cont.)

EMERGENCY REPAIRS

Emergency repairs are recognized if the parts are not available within 30 days or the repairs are not completed within 30 days. If an International® dealer is not reasonably available, the vehicle owner or any service establishment can install any replacement part.

Navistar will reimburse you for emergency repairs (including diagnostics) for the following:

- Replacement parts that do not exceed manufacturer's suggested retail price.
- Labor charges based on manufacturer's recommended time allowance and geographic hourly rate.

Replaced parts and paid invoices must be given to an International® dealer for reimbursement of emergency repairs.

WHAT IS NOT COVERED BY WARRANTY

Unauthorized parts or expendable parts

- Parts other than International® service parts or ReNEWed™ parts.
- Aftermarket parts or service kits
- Non-defective parts replaced by other than International® dealer.
- Parts requiring replacement at inspection or adjustment maintenance intervals for reasons other than being defective.
- Replacement of expendable items made in connection with scheduled maintenance.

Vehicle, engine, and part malfunctions caused by the following:

- Use of incorrect fuel, engine oil, or coolant.
- Failure to maintain correct maintenance schedule.
- Incorrect adjustments, modifications, alterations, tampering or disconnection of vehicle components.
- Abuse or misuse of engine.
- Accidents, acts of nature or other events beyond control of Navistar.

Conditions not covered by warranty

- Vehicles registered and normally operated outside the United States.
- Loss of time, inconvenience, use of vehicle/engine or commercial loss.
- Vehicles with an altered or disconnected odometer or hourmeter when mileage or hours cannot be determined.

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Federal Emission System Warranty (cont.)

WARRANTY RIGHTS AND RESPONSIBILITIES

Navistar assures that the emission warranty is being properly administered. If you have not received satisfactory service or have questions regarding your warranty rights and responsibilities, contact the regional office for assistance. The address and phone number of each regional office is listed in your vehicle *Operator's Manual*. If additional assistance is required, contact the Manager of Customer Relations.

Manager, Customer Relations
Navistar, Inc.
4201 Winfield Road
Warrenville, Illinois 60555
(Telephone 1-800-448-7825)

California Emission System Warranty

WARRANTY PERIOD

Navistar, Inc. warrants your heavy heavy-duty diesel engine for the following warranty period (whichever comes first):

- 5 years
- 160,000 km (100,000 miles)
- 3,000 hours
- Or if covered by any basic or extended warranty (if greater than above)

Your heavy-heavy duty diesel engine conforms to applicable California Air Resources Board (CARB) regulations. This vehicle is registered and certified for sale in California.

The engine model year, service class, and required emission information is on the emission label on top of the high pressure charge air cooler. This warranty is based on the engine model year, not the model year of the vehicle. The warranty period begins on the date the new vehicle is delivered to the first retail purchaser.

REQUIRED MAINTENANCE

As the vehicle owner, you are responsible for all required maintenance described in this manual. Navistar recommends that you retain all receipts covering maintenance on your truck, but Navistar will not deny warranty solely for the lack of receipts or your failure to ensure the performance of all scheduled maintenance. However, a claim may be denied if Navistar demonstrates that the (engine/vehicle) has been abused, neglected, or improperly maintained, and that such abuse, neglect, or improper maintenance was the direct cause of the need for the repair or replacement of the part. Take your vehicle to an International® dealer when a problem occurs.

WARRANTY REPAIRS AND SERVICE

All emission control system parts proven defective during normal use will be repaired or replaced during the warranty period. Warranty repairs and service will be done by any authorized International® dealer with no charge for parts, labor and diagnostics. Warranty repairs should be completed in a reasonable time, not to exceed 30 days. Navistar may deny you warranty coverage if your vehicle or a part has failed due to abuse, neglect, improper maintenance or unapproved modifications.

RECOMMENDED MAINTENANCE OR REPAIR PARTS

International® service parts or International® ReNEWed™ parts are recommended for maintenance or repairs to maintain the original quality of your emission certified engine. If parts not recommended by International® cause damage to the engine or vehicle, the warranty is invalid and maintenance and repair costs will not be covered.

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California Emission System Warranty (cont.)

EMERGENCY REPAIRS

Emergency repairs are recognized if the parts are not available within 30 days or the repairs are not completed within 30 days. If an International® dealer is not reasonably available, the vehicle owner or any service establishment can install any replacement part.

Navistar will reimburse you for emergency repairs (including diagnostics) for the following:

- Replacement parts that do not exceed manufacturer's suggested retail price.
- Labor charges based on manufacturer's recommended time allowance and geographic hourly rate.

Replaced parts and paid invoices must be given to an International® dealer for reimbursement of emergency repairs.

WHAT IS COVERED BY WARRANTY

New vehicles and engines, registered and certified for sale in California, have the following items covered by the emission warranty when first installed on the engine as original equipment by Navistar:

- Fuel injection system
- Air induction system (includes turbocharger, exhaust manifold, and intake air duct)
- Positive Crankcase Ventilation (PCV) system – if applicable (includes PCV valve and oil fill cap)
- Diesel Particulate Filter (DPF)
- Hoses, clamps, fittings and tubing
- Pulleys, belts and idlers
- Vacuum, temperature and time sensitive valves and switches

WHAT IS NOT COVERED BY WARRANTY

Unauthorized parts or expendable parts

- Parts other than International® service parts or International® ReNEWed™ parts.
- Aftermarket parts or service kits
- Non-defective parts replaced by other than International® dealer.
- Parts requiring replacement at inspection or adjustment maintenance intervals for reasons other than being defective.

California Emission System Warranty (cont.)

WHAT IS NOT COVERED BY WARRANTY (cont.)

- Replacement of expendable items made in connection with scheduled maintenance.

Vehicle, engine, and part malfunctions caused by the following:

- Use of incorrect fuel, engine oil, or coolant
- Failure to maintain correct maintenance schedule
- Incorrect adjustments, modifications, alterations, tampering or disconnection of vehicle components.
- Abuse or misuse of engine
- Accidents, acts of nature or other events beyond control of International®.

Conditions not Covered by Warranty

- Vehicles registered and normally operated outside the United States.
- Loss of time, inconvenience, use of vehicle/engine or commercial loss.
- Vehicles with an altered or disconnected odometer or hourmeter when mileage or hours cannot be determined.

WARRANTY RIGHTS AND RESPONSIBILITIES

Navistar assures that the emission warranty is being properly administered. If you have not received satisfactory service or have questions regarding your warranty rights and responsibilities, contact the regional office for assistance. The address and phone number of each regional office is listed in your vehicle *Operator's Manual*. If additional assistance is required, contact the Manager of Customer Relations.

Manager, Customer Relations
Navistar, Inc.
4201 Winfield Road
Warrenville, Illinois 60555
(Telephone 1-800-448-7825)

If further questions of warranty rights and responsibilities remain, contact:

The Air Resources Board
9528 Telstar Avenue
El Monte, California 91731

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Engine Serial Number

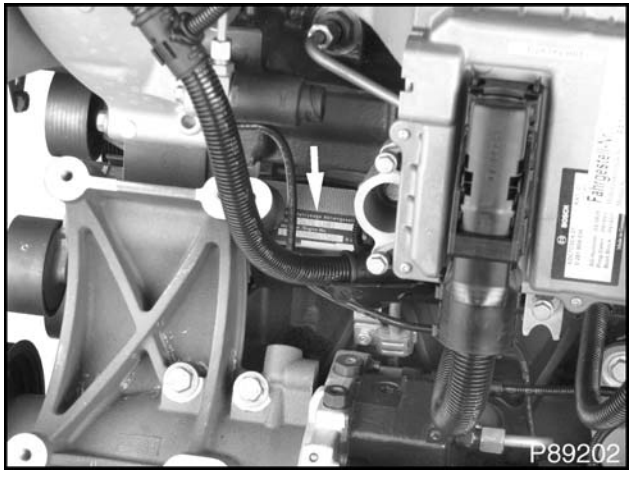

Figure 1 Engine serial number

The engine serial number is located on the upper left side of the crankcase below the cylinder head.

Engine Serial Number Examples

International® MaxxForce® 11: 105HM2D4000001

International® MaxxForce® 13: 124HM2D4000001

International® MaxxForce® 11: 105HM2Y4001000

International® MaxxForce® 13: 124HM2Y4001000

Engine Serial Number Codes

105 – Engine displacement
124 – Engine displacement
H – Diesel, turbocharged, Charge Air Cooler (CAC) and electronically controlled
M2 – Motor truck
D – Germany
Y – United States, Huntsville
7 digit suffix – Engine serial number sequence

Engine Emission Label

MAXXFORCE
INTERNATIONAL DIESEL POWER
IMPORTANT ENGINE INFORMATION
ENGINE MANUFACTURED BY:
NAVISTAR, INC.
MODEL YEAR 2008
ADV BHP @ RPM 330@1900
LB-FT TORQ. @ RPM 1250@1000
DISPLACEMENT in³ 10.5L
ENGINE S/N in³
MODEL GDT330
ENGINE FAMILY MAXFORCE 11
EMISSIONS FAMILY 8NVXH0641AGA
LABEL NUMBER 3004782C2
VALVE LASH-COLD- XX mm(.XXX in) INT. & XXX mm (.XXXin) EXH
EMISSIONS CONTROL SYSTEMS DI , TC , ECM , CAC , EGR , DOC, PTOX
FAMILY EMISSION LIMITS (g/bHp - hr)
THIS ENGINE HAS A PRIMARY INTENDED SERVICE APPLICATION AS A HEAVY HEAVY-DUTY DIESEL ENGINE AND CONFORMS TO U.S. EPA, CALIFORNIA, AND CANADIAN REGULATIONS APPLICABLE FOR 2008 MODEL YEAR AND IS CERTIFIED TO OPERATE ON ULTRA LOW SULFUR DIESEL FUEL. THIS ENGINE IS NOT CERTIFIED FOR USE IN AN URBAN BUS AS DEFINED AT 40CFR86.093-2. SALE OF THIS ENGINE FOR USE IN AN URBAN BUS IS A VIOLATION OF FEDERAL LAW UNDER THE CLEAN AIR ACT. THIS ENGINE MEETS EMD REQUIREMENTS.
CURB IDLE , FUEL RATE @ ADV . POWER AND INJECTION TIMING ARE NON-ADJUSTABLE
P89223

Figure 2 U.S. Environmental Protection Agency (EPA) exhaust emission label (example)

The U.S. Environmental Protection Agency (EPA) exhaust emission label is attached on top of the valve cover (center left side). The EPA label typically includes the following:

- Model year
- Engine family, model, and displacement
- Advertised brake horsepower and torque rating
- Emission family and control systems
- Valve lash specifications
- Engine serial number
- EPA, EURO, and reserved fields for specific applications

Engine Accessory Labels and Identification Plates

The following engine accessories may have manufacturer's labels or identification plates:

- Air compressor
- Air conditioning compressor
- Alternator
- Cooling fan clutch
- Power steering pump
- Starter motor

Engine Accessory Labels and Identification Plates (cont.)

- Engine Control Module (ECM)
- Engine Interface Module (EIM)
- Aftertreatment Control Module (ACM)

Engine Specifications and Features

International® MaxxForce® 11 and 13 Diesel Engines	
Engine Configuration	4 stroke, inline six cylinder diesel
Advertised brake horsepower @ rpm	
• MaxxForce® 11	See EPA exhaust emission label
• MaxxForce® 13	See EPA exhaust emission label
Peak torque @ rpm	
• MaxxForce® 11	See EPA exhaust emission label
• MaxxForce® 13	See EPA exhaust emission label
Displacement	
• MaxxForce® 11	10.5 L (641 in^3)
• MaxxForce® 13	12.4 L (758 in^3)
Compression ratio	17.0:1
Stroke	

Engine Specifications and Features (cont.)

• MaxxForce® 11	155 mm (6.10 in)
• MaxxForce® 13	166 mm (6.54 in)
Bore (sleeve diameter)	
• MaxxForce® 11	120 mm (4.72 in)
• MaxxForce® 13	126 mm (4.96 in)
Firing order	1-5-3-6-2-4
Aspiration	Dual turbocharged and Charge Air Cooled (CAC)
Combustion system	Direct injection turbocharged
Fuel system	High pressure common rail
Lube system capacity (including filter)	40 L (42 qts)
Lube system capacity (overhaul only, with filter)	44 L (46 qts)
Engine lubrication oil pressure at operating temperature with SAE 10W-30 oil	
• Low idle	138 - 172 kPa (20 - 25 psi)
• High idle	448 - 586 kPa (65 - 85 psi)
Idle speed (no load)	600 rpm, nominal
Thermostats operating temperature	81 °C - 92 °C (178 °F - 197 °F)

Engine Specifications and Features (cont.)

STANDARD FEATURES

The MaxxForce® 11 and 13 diesel engines have been designed for increased durability, reliability, and ease of maintenance.

The cylinder head has four valves per cylinder with centrally located fuel injectors directing fuel over the pistons. This configuration provides improved performance and reduces emissions.

The overhead camshaft is supported by seven bearings in the cylinder head. The camshaft gear is driven from the rear of the engine. The overhead valve train includes roller rocker arms and dual valves that open using a valve bridge.

The MaxxForce® 11 engines use aluminum pistons, and the MaxxForce® 13 engines use one piece steel pistons. All pistons use an offset piston axis and centered combustion bowls. Crown markings show correct piston orientation in the crankcase.

The one piece crankcase can withstand high pressure loads during operation. The crankcase uses replaceable wet cylinder sleeves that are sealed by dual crevice seals.

The crankshaft has seven main bearings with fore and aft thrust controlled at the sixth bearing. One fractured cap connecting rod is attached at each crankshaft journal. The piston pin moves freely inside the connecting rod and piston. Piston pin retaining rings secure the piston pin in the piston. The rear oil seal carrier is part of the flywheel housing.

A gerotor lube oil pump is mounted behind the front cover and is driven by the crankshaft. Pressurized oil is supplied to engine components. All MaxxForce® 11 and 13 engines use an engine oil cooler and cartridge engine oil filter.

The low pressure fuel supply pump draws fuel from the fuel tank through the fuel supply pump to the fuel filter housing. The housing includes a strainer, filter, primer pump, fuel pressure sensor, and drain valve. Conditioned fuel is then pumped through the high pressure fuel pump towards the fuel injectors.

The fuel injection system is direct common-rail. The system includes a high pressure fuel pump, fuel rail, and fuel injectors. The injectors are installed in the cylinder head under the valve cover.

The Maxxforce® 11 and 13 engines use dual turbochargers with an air-to-liquid CAC after each stage.

The cold start assist system warms the incoming air supply during cranking to aid cold engine starting and reduce white smoke during warm-up.

The Exhaust Gas Recirculation (EGR) system circulates cooled exhaust into the intake air stream in the intake manifold. This cools the combustion process and reduces the formation of oxides of nitrogen (NO_x) engine emissions.

An open crankcase breather system uses an engine mounted oil separator to return oil to the crankcase and vent crankcase pressure to the atmosphere.

STANDARD FEATURES (cont.)

The engine retarder is available for all engine displacements. The engine retarder is a compression release retarder system that provides additional braking performance. The operator can control the engine retarder for different operating conditions.

OPTIONAL COLD CLIMATE FEATURES

Optional cold climate features available include the following:

- Oil pan heater
- Coolant heater

Both heaters use an electric element to warm engine fluids in cold weather conditions.

The oil pan heater warms engine oil to ensure optimum lubrication oil flow.

The coolant heater warms the engine coolant surrounding the cylinders. Warmed engine coolant aids in performance and fuel economy during start-up

CHASSIS MOUNTED FEATURES

The aftertreatment system, part of the larger exhaust system, processes engine exhaust so that it meets tailpipe emission requirements.

- The Diesel Oxidation Catalyst (DOC) oxidizes hydrocarbons and carbon monoxide, provides heat for exhaust system warmup, and aids in temperature management for the Diesel Particulate Filter (DPF) for passive DPF regeneration.
- The DPF temporarily stores carbon-based particulates then converts and stores them as non-combustible ash.

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Component Location – Top

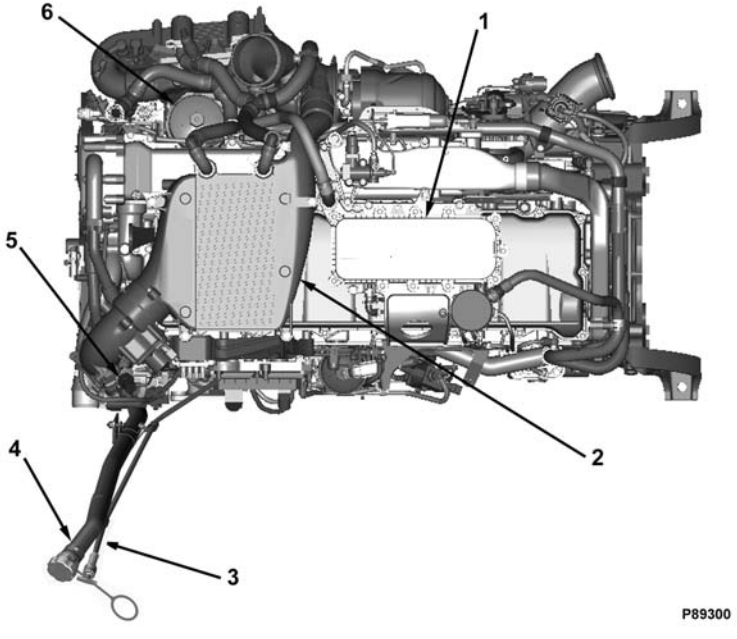

Figure 3 Top (low mount fan drive application shown)

1. Service breather assembly
2. High pressure CAC
3. Oil level gauge tube
4. Oil fill tube
5. Glow plug
6. Oil filter cover

Component Location – Front

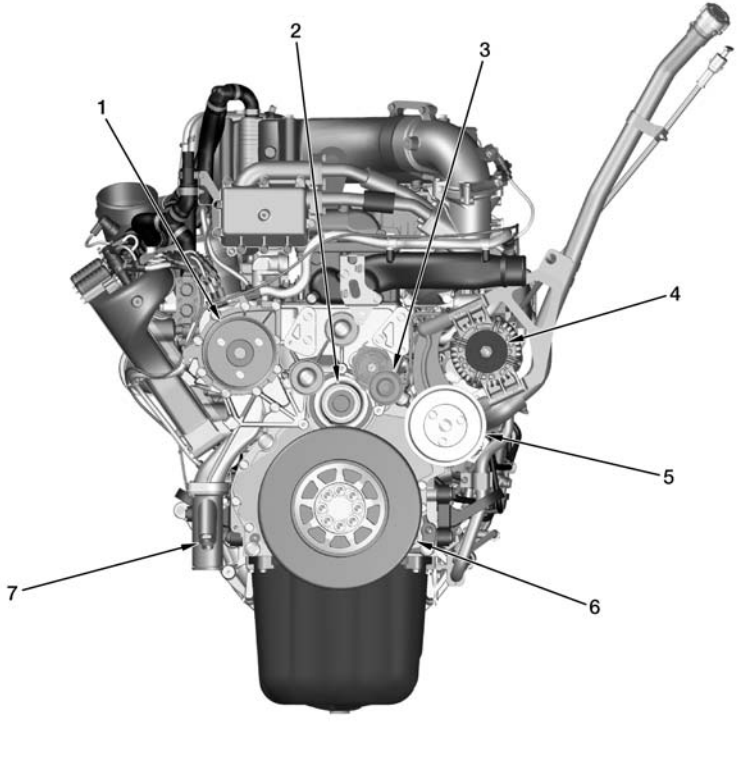

Figure 4 Front (low mount fan drive application shown)

1. Water pump pulley
2. Low mount fan drive
3. Automatic belt tensioner
4. Alternator pulley
5. Accessory drive pulley
6. Vibration damper
7. Coolant heater

Component Location – Left

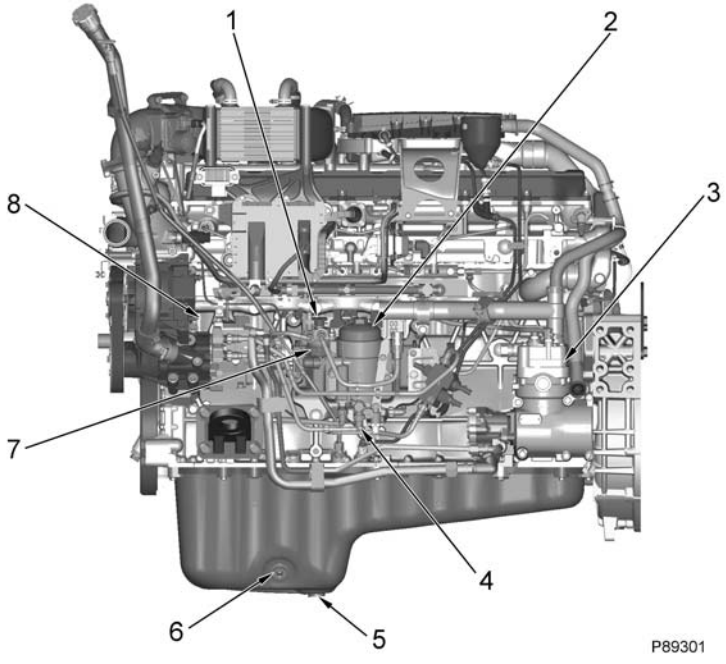

Figure 5 Left (low mount fan drive application shown)

1. Fuel primer pump
2. Fuel filter
3. Air compressor
4. Water drain valve
5. Oil drain plug
6. Oil preheater (optional)
7. Fuel strainer
8. Oil sample valve (optional)

Component Location – Right

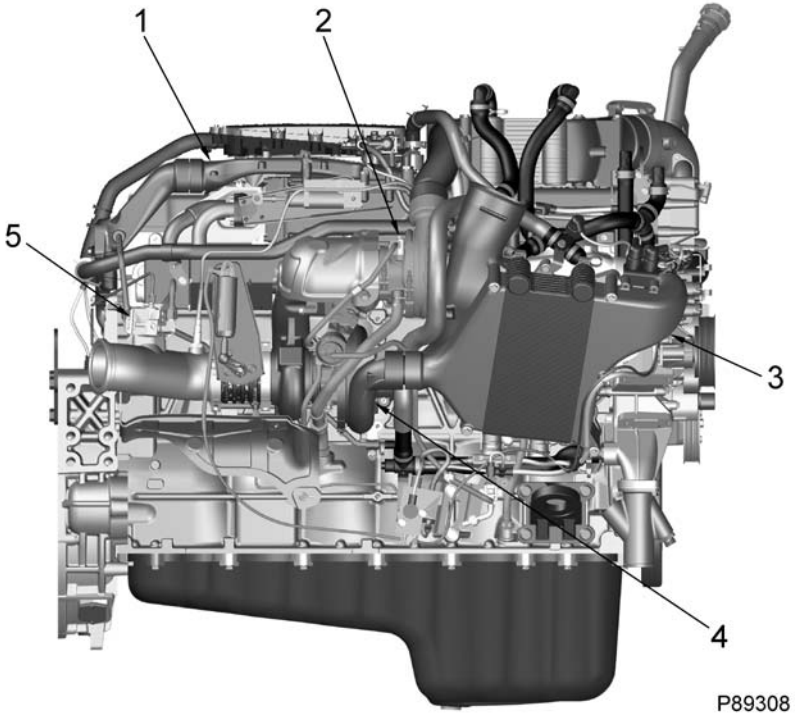

Figure 6 Right (low mount fan drive application shown)

1. Exhaust Gas Recirculation (EGR) cooler
2. High pressure turbocharger
3. Low pressure CAC
4. Low pressure turbocharger
5. Aftertreatment Fuel Injector (AFI)

Fuel

ULTRA LOW SULFUR DIESEL (ULSD)

ULTRA-LOW SULFUR
HIGHWAY DIESEL FUEL
(15 ppm Sulfur Maximum)
Required for use in all model year 2007 and later highway diesel vehicles and engines.
Recommended for use in all diesel vehicles and engines.
K35145

Figure 7 American Petroleum Institute (API) Diesel Pump Label

The API Diesel Pump Label is compliant with EPA CFR 80.570.

GOVERNMENT REGULATION: Diesel fuel sold for use in 2007 and later highway vehicles must be limited to a sulfur content of 15 parts per million (ppm).

Ultra Low Sulfur Diesel (ULSD) fuel is required for International® MaxxForce® 11 and 13 Diesel Engines used with advanced aftertreatment systems. The fuel should meet all the specifications of ASTM D975 standard (current year revision), including the EPA specification for sulfur content (0.0015 % mass or 15 ppm maximum). These specifications are included in the standard under the designation No. 2-D S15 fuel and No. 1-D S15 fuel. Grade No. 1-D fuel is a lighter fuel with higher volatility than grade No. 2-D; it may be blended with grade No. 2-D in wintertime to provide engine operability under low ambient temperature.

UNACCEPTABLE FUEL AND BLENDS

- Off road diesel fuel
- Low Sulfur Diesel (LSD) fuel 0.05% (500 ppm)
- Commercial Jet A or JP8 aviation fuel
- Heating or furnace oil
- Biodiesel B100 (neat biodiesel)
- Biodiesel blends higher than 20%

Fuel (cont.)

UNACCEPTABLE FUEL AND BLENDS (cont.)

Biodiesel fuels are methyl or ethyl esters derived from a broad variety of renewable sources such as vegetable oils, animal fats, and waste cooking oils. These oxygenated organic compounds have key properties that are comparable to those in diesel fuel.

ACCEPTABLE FUEL BLENDS

- Ultra low sulfur kerosene (No. 1-D S15 diesel fuel) blended with No. 2-D S15 fuel to improve cold weather performance. Blend rate would depend upon regional low temperatures.
- Lower biodiesel blends up to B5 (a blend of 5% neat biodiesel with 95% diesel fuel).

  Such blends have characteristics indistinguishable from diesel fuel, if the two components meet the requirements of their respective standards: ASTM D6751 current revision, for neat biodiesel and ASTM D975 current revision, for ultra low sulfur diesel fuel.

  As of October 1, 2008 blends of upto 5% biodiesel are included in the diesel fuel standard ASTM D975-08a. (D975-08a designates the 2008 revision of the standard.)

Navistar, Inc. approves of blends up to B5, provided that the two components satisfy current specifications. Quality biodiesel blends up to B5 should not cause engine or fuel system problems.

USE OF HIGHER BIODIESEL FUEL BLENDS (B6 TO B20)

A new standard ASTM D7467-08 covers the specifications for blends between 6% and 20% (B6 to B20). These blends may be used in vehicles that operate in populated areas or in fleets which are required to use alternative fuels to reduce urban pollution.

Use of B6 to B20 blends is at the discretion of the customer/operator and will not automatically void an engine warranty. However, if engine component failure can be directly attributable to use of a B6 to B20 blend not provided by a BQ9000 certified fuel supplier or not meeting the ASTM D7467-08 Standard, Navistar may, at its option, deny warranty on the affected engine or engine component.

Navistar recommends that users of B20 select a BQ9000 certified fuel supplier and request proof from the supplier that the fuel meets the ASTM D7467-08 Standard. Fuels not meeting the specification may cause fuel system deposits, plugged filters, contaminated engine oil, and fuel degradation.

If providers and customers follow correct storage and maintenance procedures for fuel and equipment, blends of B6 to B20 that meet the ASTM D7467-08 Standard should perform satisfactorily in diesel engines. Contact your International® dealer for further information on ASTM standards and recommendations for correct storage and maintenance procedures.

Fuel (cont.)

USE OF HIGHER BIODIESEL FUEL BLENDS (B6 TO B20) (cont.)

Navistar, Inc. follows the official position of the Engine Manufacturers Association (EMA) on biodiesel fuel. See www.enginemanufacturers.org for more information.

UNSAFE PRACTICES

WARNING: To prevent personal injury or death, do not mix gasoline, gasohol, or alcohol with diesel fuel. An open heat source, spark, cell phone or electronic device can ignite these fuel mixtures. This creates a fire hazard and possible explosion.

CAUTION: To prevent engine damage, do not mix propane with diesel fuel. Navistar will not honor warranty claims against engines that have used propane.

Engine Oil

ENGINE OIL QUALITY AND SERVICE CATEGORIES

The American Petroleum Institute (API) defines engine oil quality by service categories that define oil performance measured in standardized engine tests.

API CJ-4 FOR HIGH PERFORMANCE DIESEL ENGINES

Figure 8 API Identification symbol

API CJ-4 oils are recommended for high speed diesel engines with advanced exhaust aftertreatment systems that meet 2007 on-highway exhaust emission standards.

API CJ-4 oils provide protection against the following:

- Catalyst poisoning and particulate blockage
- Engine wear
- Piston deposits
- Soot related viscosity increase, deposits, and wear
- Viscosity loss due to shear
- Oxidative thickening
- Oil foaming and aeration

API CJ-4 oil, in combination with Ultra Low Sulfur Diesel (ULSD) fuel [0.0015% (15 ppm) maximum sulfur content], is recommended to maintain performance and durability of aftertreatment systems meeting 2007 diesel emission regulations.

API CI-4 oils are allowed in diesel engines that meet these regulations. Use of the CI-4 engine oil shortens Diesel Particulate Filter (DPF) cleaning service intervals.

Engine Oil (cont.)

OIL VISCOSITY

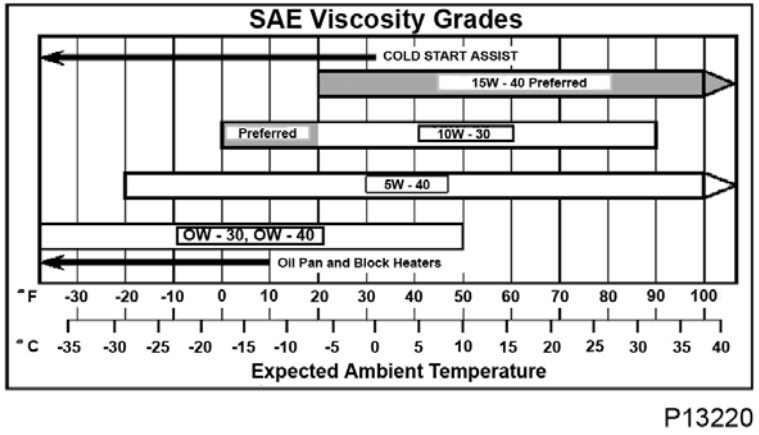
SAE Viscosity Grades
COLD START ASSIST
15W - 40 Preferred
Preferred
10W - 30
5W - 40
OW - 30, OW - 40
Oil Pan and Block Heaters
°F -30 -20 -10 0 10 20 30 40 50 60 70 80 90 100
°C -35 -30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30 35 40
Expected Ambient Temperature
P13220

Figure 9 SAE viscosity grades and temperature ranges

The Society of Automotive Engineers (SAE) defines oil viscosity (thickness) by grade. Colder temperatures require lower grade oils for correct flow during starting. Higher temperatures require higher grade oils for satisfactory lubrication.

- A block coolant heater and oil pan heater are required if temperatures are below -12 °C (10 °F).
- For heavy duty driving or trailer towing, higher oil grades 15W-40 and 5W-40 oils are required if temperatures are over 10 °C (50 °F).

For oil system capacity and service, see Section 5 Maintenance Schedule and Service Procedures.

Coolant

COOLANT MIXTURES

Engine coolant mixtures include water, glycol (ethylene or propylene), and inhibitors. Conventional and fully formulated coolants require regular testing of inhibitor levels to maintain safe levels of protection. Testing of conventional coolant determines levels of nitrite, nitrite/molybdate, and freeze point protection. If necessary, Supplemental Coolant Additives (SCAs) are added to replenish inhibitors.

Extended life coolant mixtures (water and ethylene glycol) do not require regular testing of inhibitor levels or addition of SCAs. See Section 5 “MAINTENANCE SCHEDULE AND SERVICE PROCEDURES”(page 51) in this manual for service interval.

SHELL ROTELLA® EXTENDED LIFE COOLANT (ELC) – RED

Part Numbers for ROTELLA® Extended Life Coolant (premix, concentrate, and extender)

2000 gal (50/50 Premix) ROTELLA® 9404200001	55 gal (Concentrate) ROTELLA® 940410055
55 gal (50/50 Premix) ROTELLA® 94042000055	1 gal (Concentrate) ROTELLA® 9404106021
1 gal (6/pack 50/50 Premix) ROTELLA® 9404206021	1 qt US (6/pack 50/50 Extender) ROTELLA® 9404306031

Shell ROTELLA® Extended Life Coolant (ELC) 50/50 Premix is the standard factory fill for the cooling system. If a customer wishes to use a different coolant, it should minimally meet ASTM D6210, Standard Specification for fully - Formulated Glycol Base Engine Coolant for Heavy Duty Engines.

ROTELLA® ELC 50/50 Premix provides freeze protection to -36 °C (-34 °F) and maximum corrosion protection. ROTELLA® ELC 50/50 Premix is used to replenish coolant loss and ensure that glycol/water concentrations stay in balance.

ROTELLA® ELC 50/50 Extender is added at the designated service interval. See Section 5 - Maintenance Schedule and Service Procedures (page 51) in this manual.

Freeze Point Protection Levels Provided by ROTELLA® Concentrate and Water Mixtures

Concentrate and Water Mixtures	Freeze Point Protection
40% ROTELLA® Concentrate and 60% water	-24.4 °C (-12 °F)
50% ROTELLA® Concentrate and 50% water	-36.7 °C (-34 °F)
60% ROTELLA® Concentrate and 40% water	-52.0 °C (-62 °F)
67% ROTELLA® Concentrate and 33% water	-70.6 °C (-95 °F)

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Coolant (cont.)

SHELL ROTELLA® EXTENDED LIFE COOLANT (ELC) – RED (cont.)

For vehicles operating in extremely cold climates, a coolant mixture of 60% ROTELLA® Concentrate and 40% water or 67% ROTELLA® Concentrate and 33% water provide additional freeze protection as shown in the previous table. Mixtures having more than 67% ROTELLA® Concentrate are not recommended.

For cooling system service, see Section 5 Maintenance Schedule and Service Procedures.

CONTAMINATION OF COOLANT

The coolant color can help indicate the condition of the coolant.

- Coolant color should be a reddish orange (clear – not cloudy).
- Coolant must not have floating debris or visible oil.

Contamination of ROTELLA® ELC with other coolant products will not be obvious.

To verify coolant quality, contact an International® service parts dealer and request coolant test kit ZSH297400001KIT.

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Instrument Panel Gauge Cluster

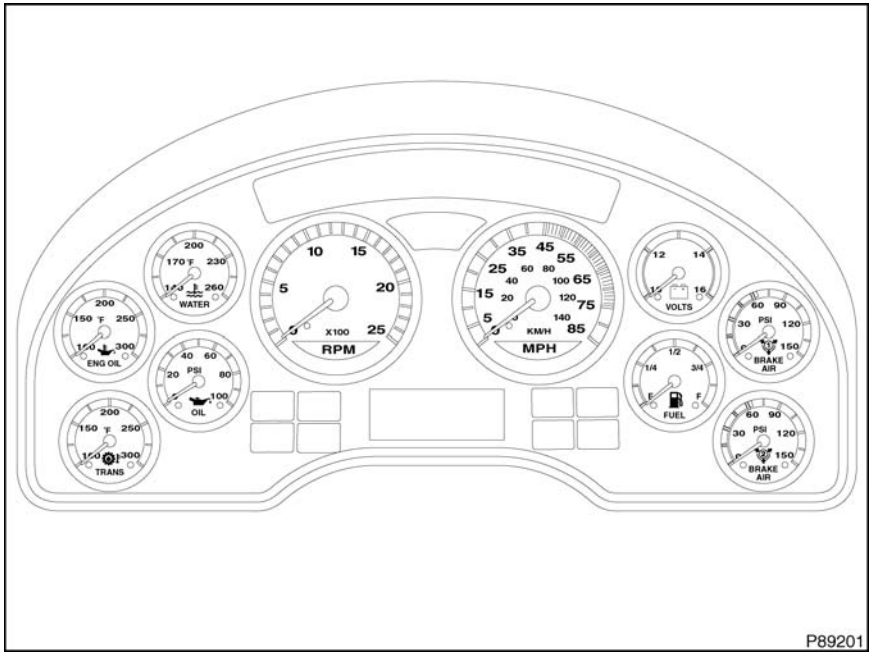

Figure 10 Typical instrument panel gauge cluster

Gauges may vary with vehicle applications. Warning and indicator lamps show conditions not indicated by the gauges.

Water Temperature Gauge

Figure 11 Water temperature gauge

The water temperature gauge indicates the temperature of coolant in the cooling system. The gauge operates only when the ignition switch is turned to ON. Normal engine operating temperature is 82 °C to 110 °C (180 °F to 230 °F).

CAUTION: To prevent engine damage – do not operate engine above 110 °C (230 °F); this may cause internal damage.

The amber indicator lamp activates at engine coolant temperatures above 110 °C (230 °F). The red indicator lamp activates at engine coolant temperatures above 113 °C (235 °F). If engine temperature suddenly rises, shut down the engine and determine the cause of overheating. If necessary contact your International® dealer.

Oil Pressure Gauge

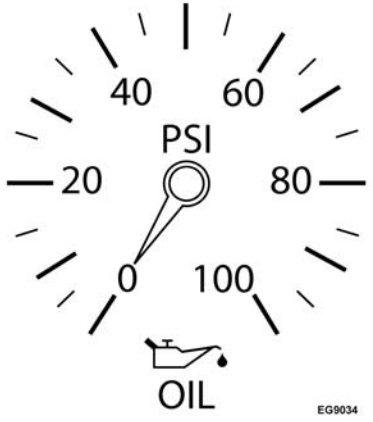

Figure 12 Oil pressure gauge

The engine oil pressure gauge indicates operating oil pressure. The engine oil pressure indicator lamp activates at pressure less than 100 kPa (14.5 psi) when engine is over 325 rpm.

Oil Pressure Gauge (cont.)

Lubrication Oil Pressure

Lube Oil Pressure At normal operating temperature	
Low idle	138 - 172 kPa (20 - 25 psi)
High idle	448 - 586 kPa (65 - 85 psi)

CAUTION: To prevent engine damage, shut down the engine immediately if the gauge fluctuates or drops to 400 kPa (58 psi) or less under load. Correct the problem.

Oil Temperature Gauge

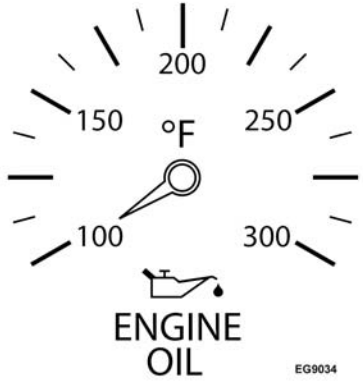

Figure 13 Oil temperature gauge

The engine oil temperature gauge indicates the operating oil temperature of the engine.

Warning Lights

Warning lights signal when a gauge reading is outside preset limits.

- Red warning lamps indicate situations that must be inspected before operating the vehicle.
- Amber warning lamps indicate situations that should be reviewed by the operator.
- An audible alarm is activated when a warning lamp is lit. This alerts the operator that an active fault exists.

Odometer

Figure 14 Odometer and Change engine oil message

1. Odometer
2. Illuminated change oil message

The change oil indicator can be programmed for kilometers, miles, hours or calculated fuel consumption. These service interval limits may be adjusted at the owner's discretion. Consult your International dealer.

The change engine oil message below the odometer illuminates after a preselected parameter is reached. This feature remains inactive until ordered active.

NOTE: If this feature is active, the system must be reset after each oil change. See Engine Oil and Filter in Section 5.

There is also a "Fuel Filter" text message that will display when the fuel filter needs replacement due to high filter restriction.

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Air Cleaner Restriction Indicators

Air restriction is resistance of airflow through the air cleaner. Accurate air restriction is measured at maximum airflow.

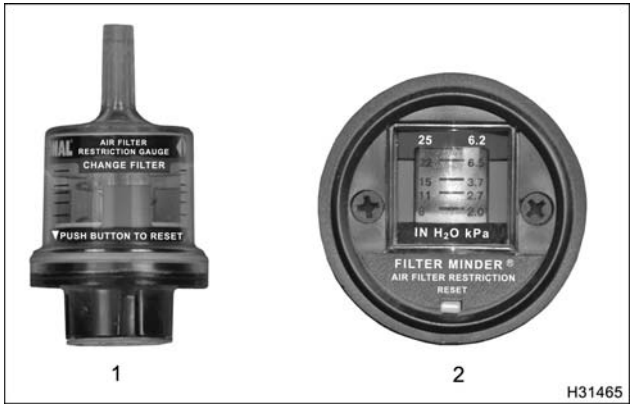

Figure 15 Air cleaner restriction indicators

1. Mounted on air cleaner
2. Mounted on instrument panel

Air cleaner restriction is measured by an air restriction indicator, mounted on the air cleaner or instrument panel.

Air Restriction Indicator Calibration

- Both indicators are calibrated in inches of water (in-H^2O).
- Both should be tested periodically (using a master vacuum gauge) to ensure correct calibration.

Air Restriction Indicator Operation

- The yellow position indicator progressively fills the window as air filter restriction increases, locking at the highest restriction at full load.
- When the yellow position indicator reaches and locks in the red zone, install a new air filter.

NOTE: If the yellow indicator locks in the red zone, it is not necessary to shut down the engine immediately, but a new air filter should be installed at the earliest convenience.

Air Restriction Indicator Reset

- The air restriction indicator should be reset, when the indicator is checked to determine air filter restriction.

  If the air filter was not changed, the yellow indicator maintains the same reading when the vehicle is driven under normal driving conditions.
- If a new air filter is installed, reset the air restriction indicator by pressing the reset button.

Switches

See vehicle *Operator Manual* for engine retarder system operation procedures.

ENGINE RETARDER ON/OFF SWITCH

Turns engine retarder system ON or OFF.

ENGINE RETARDER SELECTOR 1/2/3 SWITCH

A three position switch that selects the amount of engine braking (1 = Low, 2 = Medium, 3 = High).

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Preoperation Checklist

GOVERNMENT REGULATION: Engine fluids (oil, fuel, and coolant) may be a hazard to human health and the environment. Handle all fluids and other contaminated materials (e.g. filters, rags) in accordance with applicable regulations. Recycle or dispose of engine fluids, filters, and other contaminated materials according to applicable regulations.

WARNING: To prevent personal injury or death, provide ventilation when operating an engine in a closed area. Inhalation of exhaust gas can be fatal.

This engine has been given predelivery and delivery service by your International® dealer and is ready for operation. The operator should fully understand the use and function of all controls and instruments.

NOTE: See Service Procedures in Section 5 for the following steps.

1. Check cooling system level.

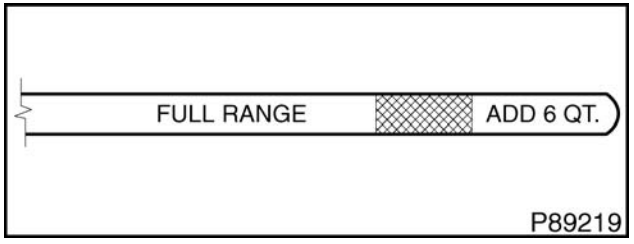

Figure 16 Oil level gauge

2. Check for correct oil level.

   CAUTION: To prevent engine damage, do not overfill with oil.

3. Inspect for coolant, fuel or oil leaks.
4. Inspect air cleaner and piping for tightness and correct installation of filter element.
5. Check for loose or hanging electrical connections.
6. Check belt condition and alignment.
7. Fill the tank with recommended fuel.
8. Inspect exhaust system for obstruction or damage.
9. Drain water from fuel system.

Priming the Fuel System

GOVERNMENT REGULATION: Engine fluids (oil, fuel, and coolant) may be a hazard to human health and the environment. Handle all fluids and other contaminated materials (e.g. filters, rags) in accordance with applicable regulations. Recycle or dispose of engine fluids, filters, and other contaminated materials according to applicable regulations.

WARNING: To prevent personal injury or death, shift transmission to park or neutral, set parking brake, and block wheels before doing diagnostic or service procedures.

WARNING: To prevent personal injury or death, do not smoke and keep fuel away from open flames and sparks.

CAUTION: To prevent engine damage, do not add fuel to the fuel filter. This can contaminate the fuel.

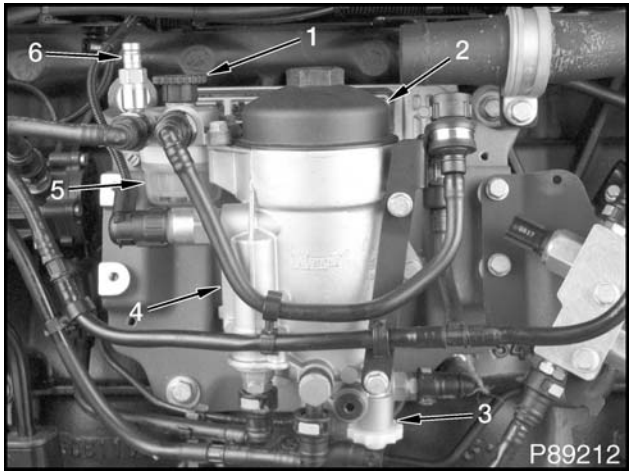

Figure 17 Fuel filter and priming pump

1. Fuel primer pump
2. Fuel filter cover
3. Water drain valve (closed)
4. Fuel filter housing
5. Fuel strainer
6. Bleeder valve

If engine runs out of fuel or the fuel filter has been drained, do the following:

1. Set parking brake and shift transmission to park or neutral.

Priming the Fuel System (cont.)

2. Turn the fuel primer pump knob counterclockwise to unlock the pump stem.
3. Fill fuel filter housing with fuel by pumping the fuel primer pump.
4. Continue operating the fuel primer pump until the pump becomes hard.
5. After priming, turn the fuel primer pump knob clockwise until tight to secure the pump stem.

Starting the Engine

WARNING: To prevent personal injury or death, do not use ether, propane, gasoline or gasohol as starting aids.

WARNING: To prevent personal injury or death, do not install ether start equipment, if an engine has a cold starting device or other cold climate starting aid.

WARNING: To prevent personal injury or death, do not use ether starting fluid to start the engine.

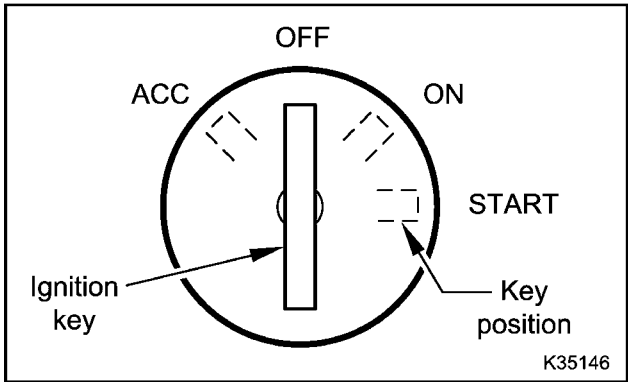

Figure 18 Ignition switch positions

1. Set parking brake and shift transmission to Park or Neutral.

CAUTION: To prevent damage to the engine, do not depress the accelerator pedal.

2. Depress clutch pedal if equipped.
3. Turn ignition switch to ON to activate the cold start assist system. The WAIT TO START lamp will illuminate continuously. Do not crank engine while lamp is on continuously.
4. When the WAIT TO START lamp begins flashing, turn ignition switch to START. If the vehicle has pushbutton starting, press and hold starter button.

Starting the Engine (cont.)

5. When the engine starts, release the ignition switch or starter button. The ignition switch returns to ON and the engine continues to run.
6. With the vehicle in neutral, release clutch pedal if equipped.
7. Until oil pressure is achieved, the engine will not accelerate and the WAIT TO START lamp will flash.

CAUTION: To prevent damage to the engine, if the engine fails to start within 20 seconds, do the following:

- Turn ignition switch to OFF and wait 2-3 minutes.
- Repeat steps 1 through 5.
- If after three attempts the engine does not start, determine the cause.
- If starting attempts are continued, the starter motor can be damaged.
- Do not accelerate engine until WAIT TO START lamp goes out.

8. Low idle speed is 600 rpm. Extended idling periods should be avoided. See Extended Idling Periods in this section. Check all gauges during warm-up.
9. Within 20 to 30 seconds after engine start, engine oil pressure should exceed 138 kPa (20 psi).

CAUTION: To prevent engine damage – do not increase engine speed until oil pressure gauge indicates normal. If oil pressure does not reach the minimum limit within 20 to 30 seconds, shutdown the engine.

10. After the engine has reached operating temperature, the oil pressure should be 448 kPa (65 psi) minimum over 1200 rpm. If oil pressure does not meet the minimum limit, stop the engine and correct the problem.

NOTE: If engine starts and then stops, repeat engine starting procedure. If more than three attempts are required, determine the cause of the no-start and correct cause of no-start.

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Emergency Starting

WARNING: To prevent personal injury or death, do not use ether starting fluid to start the engine.

WARNING: To prevent personal injury or death, do the following when jump starting an engine:

- Wear eye protection.
- Do not smoke.
- Keep flames or sparks away from battery vent openings.
- Protect against inhaling hydrogen gas fumes from battery vent openings.
- Use a 12 volt system with a negative ground.
- Do not exceed 16.0 volts, if the ignition switch is turned to OFF, ACC or ON during engine cranking.

CAUTION: To prevent engine damage, do not allow metal tools to contact positive terminal of battery.

1. Set parking brake and shift transmission to park or neutral.
2. Shut off lights, heater, air conditioner, and other electrical loads in both vehicles.
3. Make sure vehicles are not touching.

WARNING: To prevent personal injury or death, always connect jumper cable for positive battery terminals first.

4. Connect one end of the first jumper cable to the positive (+) terminal of the dead battery or to the positive (+) terminal of the jump start stud. Connect the other end to the positive (+) terminal of the charged battery.

WARNING: To prevent personal injury or death, do not attach jumper cable to a negative (-) dead battery terminal. This can cause sparks and an explosion.

5. Connect one end of the second jumper cable to the negative (-) terminal of the charged battery and the other end to chassis frame of the vehicle with the dead battery.
6. Start the engine in the vehicle that has the charged battery.
7. Start the engine in the vehicle that has the dead battery.

WARNING: To prevent personal injury or death, always disconnect jumper cable from negative contacts first.

8. Disconnect the jumper cable from negative terminal and chassis frame.
9. Disconnect the jumper cable from positive battery terminals or one terminal and jump start stud.

Operation

IDLE SPEED

WARNING: To prevent personal injury or death, provide ventilation when operating an engine in a closed area. Inhalation of exhaust gas can be fatal.

Low idle speed for the International® MaxxForce®11 and 13 diesel engines is 600 rpm. If the engine coolant temperature is below 70 °C (158 °F) and Cold Ambient Protection (CAP) is enabled, the Electronic Control Module (ECM) adjusts the low idle speed from 600 rpm to a maximum of 1000 rpm. High idle speed is a nonadjustable factory setting.

High idle speed is 2200 rpm, and is adjustable.

EXTENDED IDLING PERIODS

CAUTION: To prevent engine damage, do not extend low idle periods.

Idling periods over 15 minutes, should be avoided. Diesel engine efficiency is improved when the cylinder temperature remains high. Low temperature in cylinders may cause the following:

- Unburned fuel may seep from exhaust manifold gaskets and vehicle exhaust system connections. This seepage has the dark colored appearance of lubricating oil.
- Incomplete combustion and unburned fuel washes lubricating oil from cylinder sleeves. Unburned fuel is carried into the lubricating oil, dilutes the oil, and changes oil viscosity.
- Carbon forms on internal components of turbocharger and EGR, reducing engine efficiency.
- Carbon clogs and damages the Diesel Particulate Filter (DPF).

ENGINE IDLE SHUTDOWN TIMER (FEDERAL)

GOVERNMENT REGULATION: State and local regulations may limit engine idle time. The vehicle owner or operator is responsible for compliance with those regulations.

The optional Idle Shutdown Timer (IST) allows the ECM to shutdown the engine during extended idle. Idle time can be programmed from 2 to 120 minutes. The ECM can be programmed to deactivate the IST when the Power Takeoff (PTO) is active.

Thirty seconds before engine shutdown, the amber IDLE SHUTDOWN indicator in the instrument panel gauge cluster illuminates. This continues until the engine shuts down or the low idle shutdown timer is reset. The engine must be out of

Operation (cont.)

ENGINE IDLE SHUTDOWN TIMER (FEDERAL) (cont.)

gear for the IST to work. Engine shutdown timer will deactivate for one or more of the following conditions:

- Engine speed is not at idle speed (700 rpm).
- Vehicle movement or a Vehicle Speed Sensor (VSS) fault is detected.
- Manual DPF Regeneration is enabled.
- Accelerator pedal movement or an Accelerator Position sensor (APS) fault is detected.
- Engine coolant operating temperature is below 60 °C (140 °F).
- Ambient temperature below 16 °C (60 °F) or above 44 °C (110 °F).
- Brake pedal movement is detected or a brake switch fault is detected.
- Parking brake transition is detected.
- Clutch pedal is pressed or clutch pedal switch fault is detected (manual transmissions, if equipped with a clutch switch).
- Shift selector is moved from neutral (automatic transmissions).
- If the IST is enabled, the Cold Ambient Protection (CAP) will not function.

CALIFORNIA CLEAN IDLE

Figure 19 California Certified Clean Idle label

All vehicles that are in compliance with the clean idle calibrations will have a Certified Clean Idle label applied to the hood or door of the vehicle.

The Clean Idle label indicates the heavy duty diesel engine conforms to applicable California Air Resources Board (CARB)

Operation (cont.)

CALIFORNIA CLEAN IDLE (cont.)

regulations for extended idle periods without an Idle Shutdown Timer (IST). This vehicle is registered and certified for operation in California.

GOVERNMENT REGULATION: State and local regulations may limit engine idle time. The vehicle owner or operator is responsible for compliance with those regulations.

The optional IST may be applied to a certified Clean Idle engine. It allows the ECM to shutdown the engine during extended idle. Idle time can be programmed from 2 to 120 minutes. The ECM can be programmed to deactivate the IST when the Power Takeoff (PTO) is active.

Thirty seconds before engine shutdown, the amber IDLE SHUTDOWN indicator in the instrument panel gauge cluster illuminates. This continues until the engine shuts down or the low idle shutdown timer is reset. The engine must be out of gear for the IST to work. Engine shutdown timer will deactivate for one or more of the following conditions:

- Engine speed is not at idle speed (700 rpm).
- Vehicle movement or a Vehicle Speed Sensor (VSS) fault is detected.
- Manual DPF Regeneration is enabled.
- Accelerator pedal movement or an Accelerator Position sensor (APS) fault is detected.
- Engine coolant operating temperature is below 60 °C (140 °F).
- Ambient temperature below 16 °C (60 °F) or above 44 °C (110 °F).
- Brake pedal movement is detected or a brake switch fault is detected.
- Parking brake transition is detected.
- Clutch pedal is pressed or clutch pedal switch fault is detected (manual transmissions, if equipped with a clutch switch).
- Shift selector is moved from neutral (automatic transmissions).
- If the IST is enabled, the Cold Ambient Protection (CAP) will not function.

Operation (cont.)

ENGINE IDLE SHUTDOWN TIMER (CALIFORNIA - ENGINE SHUTDOWN SYSTEM)

GOVERNMENT REGULATION: State and local regulations may limit engine idle time. The vehicle owner or operator is responsible for compliance with those regulations.

Some heavy duty diesel engines conform to applicable California Air Resources Board (CARB) regulations without Clean Idle calibrations. These engines are equipped with a California - Engine Shutdown System (ESS). This vehicle is registered and certified for operation in California.

The CARB Idle Shutdown Timer (IST) allows the ECM to shutdown the engine during extended idle. When parking brake is set, the idle time can be programmed up to 2 minutes. When parking brake is released, the idle time can be programmed up to 15 minutes. During service, the idle time can be programmed up to 60 minutes. The ECM will deactivate the IST when the PTO is active.

Thirty seconds before engine shutdown, the amber IDLE SHUTDOWN indicator in the instrument panel gauge cluster illuminates. This continues until the engine shuts down or the low idle shutdown timer is reset. The engine must be out of gear for the IST to work. Engine shutdown timer will deactivate for one or more of the following conditions:

- Engine speed is not at idle speed (700 rpm).
- Vehicle movement or a Vehicle Speed Sensor (VSS) fault is detected.
- Manual DPF regeneration is enabled.
- Accelerator pedal movement or an Accelerator Pedal Sensor (APS) fault is detected.
- Engine coolant operating temperature is below 16 °C (60 °F).
- Brake pedal movement or a brake switch fault is detected.
- Parking brake transition is detected.
- Clutch pedal is pressed or clutch pedal switch fault is detected (manual transmissions, if equipped with a clutch switch).
- Shift selector is moved from neutral (automatic transmissions).
- If the IST is enabled, the Cold Ambient Protection (CAP) will not function.

Operation (cont.)

COLD WEATHER OPERATION

WARNING: To prevent personal injury or death, do not use ether, propane, gasoline or gasohol as starting aids.

NOTE: If operating in temperatures below -29 °C (-20 °F), contact an International® dealer for information about special cold weather equipment and precautions.

A block coolant heater and oil pan heater are recommended at temperatures below -12 °C (10 °F).

1. Before operating the engine at 0 °C (32 °F) or lower, check or service the following:
   - Correct battery size
   - Correct amount of electrolyte, if not a maintenance free battery.
   - Full battery charge
   - Condition of other electrical equipment
   - Cooling system leaks
   - Correct coolant and cooling system level
   - Recommended oil grade
2. At the end of each day of operation, perform the following:
   - Fill the fuel tank with the correct fuel.
   - Drain water from the fuel filter housing.
   - Check oil level
   - Clean external surfaces of the engine and accessories to prevent dirt or snow build up.
   - Clean outside and in between radiators to prevent dirt or snow build up.

COLD AMBIENT PROTECTION (CAP)

CAP is a standard feature on all vehicles. It safeguards the engine from damage caused by prolonged idle at no load during cold weather. CAP also improves cab warm-up.

CAP maintains engine coolant temperature by increasing engine rpm to a programmed value when ambient air temperature is below 20 °C (68 °F), coolant temperature is below 70 °C (158 °F), and engine has been idling at no load for over five minutes.

CAP is standard on all trucks without an Idle Shutdown Timer (IST), with a clutch switch (manual transmissions) or a neutral safety switch (automatic transmission).

The engine speed continues to increase or decrease to maintain a coolant temperature of 80 °C (176 °F) until the following occurs:

- Engine load is greater than 45%.
- Brake pedal is applied or brake switch fault is detected.

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Operation (cont.)

COLD AMBIENT PROTECTION (CAP) (cont.)

- Clutch pedal is pressed or clutch pedal switch fault is detected (manual transmissions, if equipped with a clutch switch).
- Shift selector is moved from neutral (automatic transmissions). Shift selector must be in neutral for CAP to work.
- Power Takeoff (PTO) switch, also used for electronic hand throttle, is turned on and actively controls engine speed.
- Accelerator pedal is pressed or Accelerator Pedal Sensor (APS) fault is detected.
- IST is enabled.
- Engine Coolant Temperature (ECT) sensor fault is detected.
- Intake Air Temperature (IAT) ambient temperature sensor fault is detected.

HOT WEATHER OPERATION

1. Before operating the engine above 21 °C (70 °F), check or service the following:
   - Full battery charge
   - Condition of other electrical equipment
   - Cooling system leaks
   - Correct coolant and cooling system level
2. At the end of each day of operation, perform the following:
   - Fill the fuel tank with the correct fuel.
   - Drain water from the fuel filter housing.
   - Check oil level.
   - Clean external surfaces of the engine and accessories to prevent dirt build up.
   - Clean outside and in between radiators to prevent dirt build up.

ENGINE SHUTDOWN

Before shutting down an engine that has reached operating temperature, idle the engine for 2 to 3 minutes, allowing the hottest engine components to dissipate some of their internal heat.

- Idling is recommended if an engine has been running at maximum horsepower.
- Idling dissipates heat.

Operation (cont.)

ENGINE WARNING PROTECTION SYSTEM (EWPS)

The Engine Warning Protection System (EWPS) warns the operator of engine conditions that can damage the engine. Optional engine shutdown is available and is activated if one or more critical conditions are detected.

The Standard Warning System is the base system in which all engines are equipped. If one of these faults are detected, the ECM will illuminate the red OIL / Water (OWL) lamp on the instrument panel, an alarm will sound, and set a corresponding Diagnostic Trouble Code (DTC).

Standard Warning

- The engine will not shut down.
- RPM - Engine over-speed warning
- ECT - Engine overheat warning

The following optional features to this base system provide added warning or protection.

2 - Way Warning (optional)

- The warning mode is an optional calibration that can be added to the EWPS by your International® dealer.
- The engine will not shut down.
- ECT - Engine overheat warning
- EOP - Low engine oil pressure warning

3 - Way Warning (optional)

- The warning mode is an optional calibration that can be added to the EWPS by your International® dealer.
- The engine will not shut down.
- ECT - Engine overheat warning
- EOP - Low engine oil pressure warning
- ECL - Low engine coolant level warning

NOTE: The protection mode is not offered for school buses or emergency vehicles.

3 - Way Protection (optional)

- The protection mode is an optional calibration that can be added to the EWPS by your International® dealer.
- Engine shut down is available if critical condition is detected.
- ECT, EOP, ECL - Same as 3-way Warning
- ECT - Engine overheat warning
- EOP - Low engine oil pressure warning
- ECL - Low engine coolant level warning

Warning - Temperature above specific threshold will sound a buzzer, illuminate the red Oil / Water (OWL) lamp and set a DTC.

Operation (cont.)

ENGINE WARNING PROTECTION SYSTEM (EWPS) (cont.)

Critical - Temperature above specific threshold will shutdown the engine and set a DTC. The operator has 30 seconds to safely pull vehicle off the road before the engine shuts off. A red STOP ENGINE warning lamp will illuminate before engine shutdown is approaching. The ECM allows the engine to be restarted and run for 30 second periods.

Event log - This feature logs occurrences of the event according to the engine hours and odometer readings.

PARKING

WARNING: To prevent personal injury or death, do the following after parking vehicle:

- Set transmission to park or neutral.
- Set parking brake.
- Block wheels or turn wheels toward curb.

Operation (cont.)

ROAD OPERATION

Correct road operation of your vehicle provides the following:

- Satisfactory engine performance
- Maximum fuel economy
- Long service life

General guidelines for correct road operation

1. Use the lowest gear to get the vehicle moving. This allows the engine to easily move the load.
2. Accelerate smoothly and evenly to engine's rated speed. Rapid acceleration causes high fuel consumption.
3. To prevent lugging, do not allow engine speed to drop below 1,000 rpm during full throttle.
4. When approaching a hill, press accelerator smoothly to start the upgrade at full power. Downshift to maintain maximum vehicle speed.

DOWNHILL OPERATION

CAUTION: To prevent engine damage when driving downhill, do not operate the engine above high idle.

Protect your engine when driving downhill as follows:

- Prevent overspeeding of engine when going down long and steep grades.
- Operate the engine closest to high idle for maximum retarder system operation.
- See vehicle *Operator Manual* for engine retarder system operation procedures.

NOTE: When the retarder system is activated, the engine cooling fan may engage. This is normal operation. The engine fan provides additional braking power through its parasitic loading on the engine.

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Maintenance Schedule

International® MaxxForce® 11 and 13 Diesel Engines

Service operation interval - whichever comes first: kilometers (miles), months, years, hours, or liters (gallons) of fuel

Service Interval	Service Operation See service procedures in this section for more information.
Daily	Check engine oil level. Check coolant level. Check for external leaks. Check air cleaner restriction indicator.
Weekly	Drain water separator. (Both engine and vehicle. See Water Separator in this section of this *Engine Operation and Maintenance Manual* for engine drain location. Refer to vehicle *Operator Manual* for vehicle drain location.)
24,100 km (15,000 miles) 6 months, 550 hours 7,949 liters (2,100 gallons) of fuel	Inspect belt, air intake piping, and clamps.
6 months	Check coolant freeze point.
40,000 km (25,000 miles) 12 months, 1,100 hours 16,000 liters (4,200 gallons) of fuel	Change engine oil and oil filter. Change fuel filter.

Maintenance Schedule (cont.)

International® MaxxForce® 11 and 13 Diesel Engines (cont.)

Service operation interval - whichever comes first: kilometers (miles), months, years, hours, or liters (gallons) of fuel

Service Interval	Service Operation See service procedures in this section for more information.
80,000 km (50,000 miles) 24 months, 2,200 hours 32,000 liters (8,400 gallons) of fuel	Clean or change fuel strainer.
Yearly	Inspect electrical system.
161,000 km (100,000 miles) 12 months	Change service breather element
161,000 km (100,000 miles) 3,000 hours	Clean Aftertreatment Fuel Injector (AFI). **NOTE:** This component is sometimes referred to as Doser Injector.
400,000 km (250,000 miles)	Adjust engine valve lash. Adjust engine retarder lash.
400,000 km (250,000 miles) 30 months, 6,000 hours	Clean Diesel Particulate Filter (DPF) [1]

Maintenance Schedule (cont.)

International® MaxxForce® 11 and 13 Diesel Engines (cont.)

Service operation interval - whichever comes first: kilometers (miles), months, years, hours, or liters (gallons) of fuel

Service Interval	Service Operation See service procedures in this section for more information.
500,000 km (300,000 miles) 3 years, 6,000 hours	Add Extended Life Coolant (ELC) Extender.
1,000,000 km (600,000 miles) 6 years, 12,000 hours	Replace engine coolant. See Service Cooling System in this section of the *Engine Operation and Maintenance Manual*.
1,930,000 km (1,200,000 miles)	Replace diesel particulate filter

[1] Reduced service interval required if allowed CI-4 engine lubrication oil is used. If using CI-4 oil, reduce DPF cleaning interval to 322,000 km (200,000 miles) 22 months, or 4,500 hours.

Maintenance Schedule (cont.)

Service Procedures

GOVERNMENT REGULATION: Engine fluids (oil, fuel, and coolant) may be a hazard to human health and the environment. Handle all fluids and other contaminated materials (e.g. filters, rags) in accordance with applicable regulations. Recycle or dispose of engine fluids, filters, and other contaminated materials according to applicable regulations.

WARNING: To prevent personal injury or death, shift transmission to park or neutral, set parking brake, and block wheels before doing diagnostic or service procedures.

OIL LEVEL

Service Interval: Daily

1. Park vehicle on level ground.

NOTE: Do not check oil level if engine is running or immediately after engine shutdown.

2. Shut down the engine and wait 5 minutes.
3. Remove oil level gauge from oil level gauge tube.

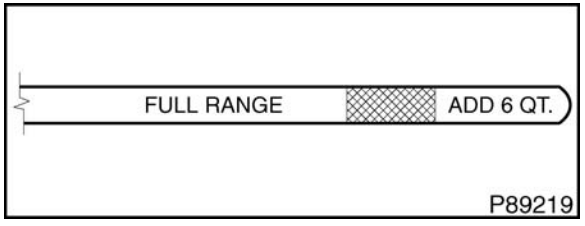

Figure 20 Oil level gauge

CAUTION: To prevent engine damage do the following:

- Assure oil level readings are within the crosshatched operating range on the oil level gauge.
- Do not overfill the engine with oil.
- Do not operate engine if oil level is above or below the operating range.

Service Procedures (cont.)

OIL LEVEL (cont.)

4. If oil level is below operating range, fill with recommended oil for operating climate. The ADD mark indicates 2.8 liters (6 quarts US) of oil should be added. See Engine Oil Quality and service categories, in Section 2.

COOLANT LEVEL

Service Interval: Daily

Shell ROTELLA® Extended Life Coolant (ELC) Premix 50/50 is the standard factory fill for the cooling system. If a customer wishes to use a different coolant, it should minimally meet ASTM D6210, Standard Specification for fully - Formulated Glycol Base Engine Coolant for Heavy Duty Engines. ROTELLA® ELC Premix 50/50 is used to replenish coolant loss and ensure that glycol/water concentrations stay in balance.

NOTE: The International® ProStar® and TransStar® vehicles are equipped with both a deaeration tank and an expansion tank. Never add ELC to the expansion tank. Only add ELC to the dearation tank per the following procedure.

Figure 21 Deaeration tank COLD MIN and MAX level marks

1. Non-vented deaeration tank cap
2. MAX coolant level
3. COLD MIN coolant level

Service Procedures (cont.)

COOLANT LEVEL (cont.)

1. Check coolant level in the deaeration tank.
   - For cold engine check, coolant level should be between the COLD MIN and MAX marks.
   - For hot engine check, coolant level should be at the MAX mark (top of deaeration tank).
   - If coolant level is below the COLD MIN mark on a cold engine or below the MAX mark on a hot engine, continue with steps 2 and 3.

WARNING: To prevent personal injury or death, do the following when removing the radiator cap or deaeration cap:

- Allow the engine to cool for 15 minutes or more.
- Wrap a thick cloth around the radiator cap or deaeration cap.
- Loosen cap slowly a quarter to half turn to vent pressure.
- Pause for a moment until all pressure has escaped to avoid being scalded by steam.
- Continue to turn cap counterclockwise to remove.

2. Remove non-vented deaeration tank cap and add ROTELLA® ELC Premix 50/50 to the correct coolant level, top of the deaeration tank (MAX mark).
3. Install and tighten non-venting deaeration tank cap.

EXTERNAL LEAKAGE

Service Interval: Daily

WARNING: To prevent personal injury or death, shut down engine, set parking brake, and block wheels before inspecting for external leakage.

1. Check for the following conditions:
   - Cracked hoses
   - Loose clamps
   - Coolant stains
   - Oil stains
   - Fuel stains
   - Leakage at water pump
2. Correct problems.

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Service Procedures (cont.)

AIR CLEANER RESTRICTION

Service Interval: Daily

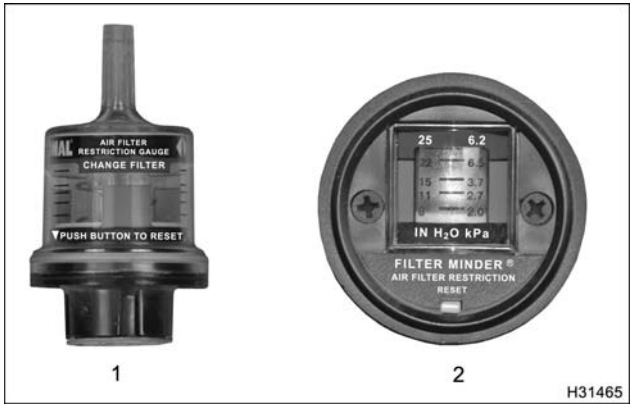

Figure 22 Air cleaner restriction indicators

1. Mounted on air cleaner
2. Mounted on instrument panel

Check air restriction indicator reading.

If the yellow position indicator has locked in the red zone, install a new air filter to prevent low engine power, reduced fuel economy, or engine damage.

1. Remove the plugged air filter element and discard.

CAUTION: To prevent engine damage, do not use compressed air to clean filter housing.

2. Use a clean water-dampened cloth to clean the inside of the air filter housing.
3. Inspect the air filter housing for damage or distortion. Install a new housing if necessary.
4. Install a new air filter element.
5. Push reset button on the air restriction indicator. The yellow indicator returns to zero.

Service Procedures (cont.)

WATER SEPARATOR

Service Interval: Weekly

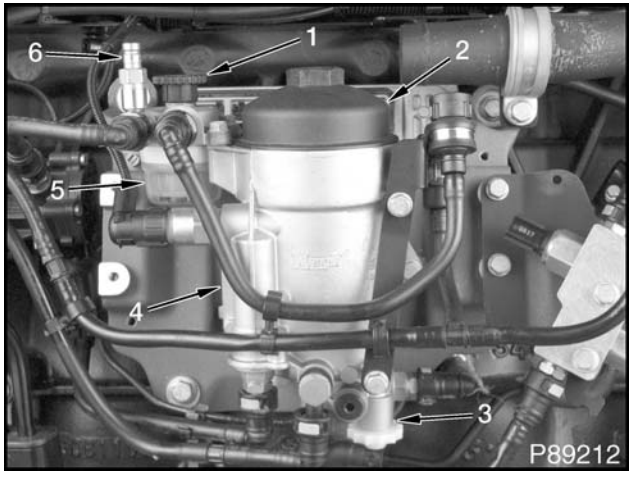

Figure 23 Fuel filter assembly

1. Fuel primer pump
2. Fuel filter cover
3. Water drain valve (closed)
4. Fuel filter housing
5. Fuel strainer
6. Bleeder valve

GOVERNMENT REGULATION: Engine fluids (oil, fuel, and coolant) may be a hazard to human health and the environment. Handle all fluids and other contaminated materials (e.g. filters, rags) in accordance with applicable regulations. Recycle or dispose of engine fluids, filters, and other contaminated materials according to applicable regulations.

WARNING: To prevent personal injury or death, do not smoke and keep fuel away from flames and sparks.

WARNING: To prevent personal injury or death, store diesel fuel properly in an approved container designed for and clearly marked DIESEL FUEL.

1. Attach a hose to the end of the water drain valve.
2. Put a suitable clear container under the hose from the water drain valve.

NOTE: Drain until the water/fuel mixture becomes only fuel. The water/fuel mixture will drain slowly and may take up to a minute to attain pure fuel flow.

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Service Procedures (cont.)

WATER SEPARATOR (cont.)

3. Turn the water drain valve to open and allow the water/fuel mixture to drain out.

NOTE: If the fuel/water mixture does not flow from the drain, push the knob on fuel primer pump once to displace fuel in the filter.

4. Close water drain valve.

5. Dispose of fuel in an approved container.

Service Procedures (cont.)

BELT, AIR INTAKE PIPING AND CLAMPS

Service Interval: 24,000 km (15,000 miles), 6 months, or 550 hours

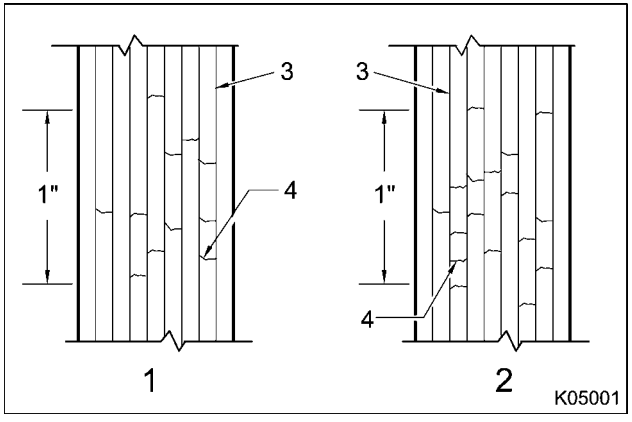

Figure 24 Cracks in belt ribs

1. Belt in good condition
2. Belt ready for replacement
3. Belt ribs
4. Cracks in belt

Install a new belt if any of the following conditions exist:

- Excessive wear
- Missing material
- Grease or oil contamination
- Over three cracks per inch in a belt rib

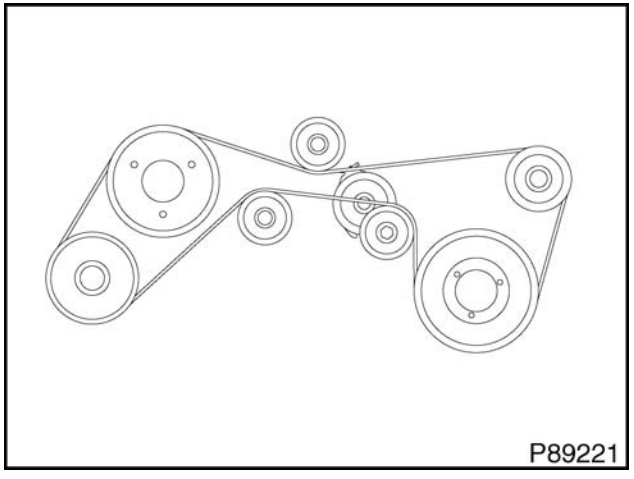

Figure 25 Accessory belt routing - low mount fan drive (shown with optional refrigerant compressor)

Service Procedures (cont.)

BELT, AIR INTAKE PIPING AND CLAMPS (cont.)

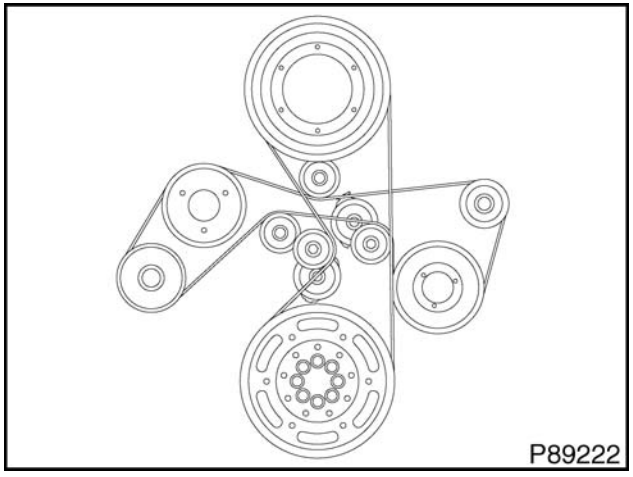

Figure 26 Accessory belt routing - high mount fan drive

1. Attach a 1/2 inch breaker bar with a 15 mm socket onto bolt on auto tensioner.
2. Pull the breaker bar clockwise and install the belt over the auto tensioner pulley and other pulleys.
3. Slowly release the breaker bar; the auto tensioner automatically adjusts.
4. Remove the breaker bar.

AIR INTAKE PIPING AND CLAMPS

For any of the following conditions, install new parts:

- Loose hoses or clamps
- Ruptured hoses
- Cracked air cleaner housing
- Damaged Charge Air Cooler (CAC)

COOLANT FREEZE POINT

Service Interval: 6 months

ROTELLA® ELC 50/50 Premix provides freeze protection to -36 °C (-34 °F) and maximum corrosion protection. If a customer wishes to use a different coolant, it should minimally meet ASTM D6210, Standard Specification for fully - Formulated Glycol Base Engine Coolant for Heavy Duty Engines. ROTELLA® ELC 50/50 Premix is used to replenish coolant loss and ensure that glycol/water concentrations stay in balance.

ROTELLA® ELC 50/50 Extender is added at the designated service interval.

Service Procedures (cont.)

COOLANT FREEZE POINT (cont.)

Freeze Point Protection Levels Provided by ROTELLA® Concentrate and Water Mixtures

Concentrate and Water Mixtures	Freeze Point Protection
40% ROTELLA® Concentrate and 60% water	-24.4 °C (-12 °F)
50% ROTELLA® Concentrate and 50% water	-36.7 °C (-34 °F)
60% ROTELLA® Concentrate and 40% water	-52. 0 °C (-62 °F)
67% ROTELLA® Concentrate and 40% water	-70.6 °C (-95 °F)

For vehicles operating in extremely cold climates, a coolant mixture of 60% ROTELLA® Concentrate and 40% water or 67% ROTELLA® Concentrate and 33% water provide additional freeze protection as shown in the table above. Mixtures having more than 67% ROTELLA® Concentrate are not recommended.

Check freeze point with a refractometer.

1. Put drop of coolant on refractometer window.
2. Look through eyepiece and focus.
3. Record freeze point.
4. Adjust coolant concentration as necessary to achieve desired freeze point protection.

ENGINE OIL AND FILTER

Service Interval: 40,000 km (25,000 miles), 12 months, 1,100 hours or 16,000 liters (4,200 gallons) of fuel

Engine Oil Sampling - Optional

Engine oil sampling can be utilized for the following:

1. Determine if specified engine oil change intervals should be shortened, based upon specific engine application.
2. Catch contaminates which, if left unattended, may result in engine failure.

The oil sample valve, if equipped, is located on the driver's side of the engine, mounted into the high-pressure pump. It is recommended to take the sample from an engine that is warm and running. Refer to your vehicle's operator manual and follow all safety information.

CAUTION: To prevent engine damage, do not extend recommended oil change intervals.

1. Park the vehicle on level ground. Set the parking brake and shift the transmission to park or neutral.

Service Procedures (cont.)

ENGINE OIL AND FILTER (cont.)

2. Run the engine until operating temperature is reached, then shut down the engine.

GOVERNMENT REGULATION: Engine fluids (oil, fuel, and coolant) may be a hazard to human health and the environment. Handle all fluids and other contaminated materials (e.g. filters, rags) in accordance with applicable regulations. Recycle or dispose of engine fluids, filters, and other contaminated materials according to applicable regulations.

WARNING: To prevent personal injury or death, wear protective clothing when draining hot oil.

WARNING: To prevent personal injury or death, do not let engine fluids stay on your skin. Clean skin and nails using hand cleaner and wash with soap and water. Wash or discard clothing and rags contaminated with engine fluids.

NOTE: The engine oil filter should always be changed before draining engine oil pan. Dirty oil in filter housing will drain to oil pan through an internal valve when changing filter.

Figure 27 Oil filter cover

1. Oil filter cover
2. O-ring

3. Remove the oil filter cover and discard the O-ring.

Service Procedures (cont.)

ENGINE OIL AND FILTER (cont.)

Figure 28 Oil filter

4. Remove the old oil filter and dispose of according to local regulations.

CAUTION: To prevent engine damage, install the oil filter into the oil filter housing, then attach and secure oil filter cover. Do not attach oil filter to oil filter cover and install as a unit into the oil filter housing. Installing the oil filter in this manner will tear the oil filter when the oil filter cover is tightened.

5. Install a new oil filter into the oil filter housing.
6. Lubricate the new oil filter cover O-ring with clean engine oil.
7. Install oil filter cover and tighten to 40 N·m (30 lbf·ft).
8. Put a drain pan under the oil pan drain plug, remove the oil pan drain plug, and drain the oil.
9. Inspect the oil pan drain plug O-ring. If it is free of defects, it can be reused. Replace if required.
10. Lubricate the oil pan drain plug O-ring with clean engine oil and put the O-ring onto the drain plug.
11. Install the oil pan drain plug and tighten to 75 N·m (55 lbf·ft).
12. Dispose of oil according to local regulations.

CAUTION: To prevent engine damage, do not overfill with oil.

13. Add correct oil viscosity, API CJ-4 oil is recommended but CI-4 is allowable. Use of CI-4 oils will reduce DPF cleaning interval, see Maintenance Schedule (page 51). Add oil through the engine oil fill tube.

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Service Procedures (cont.)

ENGINE OIL AND FILTER (cont.)

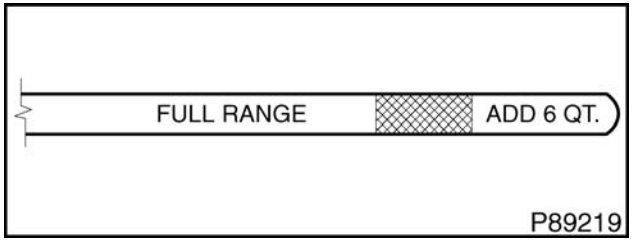

Figure 29 Oil level gauge

14. Check the oil level gauge. Oil level must be within the crosshatched operating range.
15. Start the engine and run at low idle.
16. Check the reading on the oil pressure gauge.
    - Minimum lube oil pressure is 138 kPa (20 psi) minimum @ 600 rpm.
    - If there is no gauge reading, shut the engine down immediately. Check for oil leaks.
    - Let engine run until operating temperature is reached. Check for leaks.
17. Shut down the engine for 5 minutes.

CAUTION: To prevent engine damage, do not overfill with oil.

18. Recheck oil level and add API CJ-4 oil (if needed) to bring oil level within the crosshatched operating range on gauge.

RESETTING CHANGE ENGINE OIL SERVICE INTERVAL MESSAGE

Reset the Service Interval Message (change engine oil) per the following procedure:

1. If not already done, set the parking brake.
2. Turn ignition switch to ON.
3. Turn cruise ON.
4. Turn cruise OFF.
5. Turn cruise ON.
6. Very rapidly push the resume switch four times and then hold down on the fifth time for four seconds.
7. The Change Oil message should clear.
8. The operation from the time the cruise is turned On for the second time to the fifth activation of the resume switch must take place within six seconds. If you fail to reset the message, repeat the process.

Service Procedures (cont.)

FUEL FILTER

Service Interval: 40,000 km (25,000 miles), 12 months, 1,100 hours or 16,000 liters (4,200 gallons) of fuel

NOTE: Change the fuel filter before recommended service interval if the Fuel Filter text message is illuminated.

NOTE: If fuel used has more than average impurities, shorter service intervals may be required.

GOVERNMENT REGULATION: Engine fluids (oil, fuel, and coolant) may be a hazard to human health and the environment. Handle all fluids and other contaminated materials (e.g. filters, rags) in accordance with applicable regulations. Recycle or dispose of engine fluids, filters, and other contaminated materials according to applicable regulations.

WARNING: To prevent personal injury or death, store diesel fuel properly in an approved container designed for and clearly marked DIESEL FUEL.

CAUTION: To prevent engine damage, do not add fuel to the fuel filter housing; this can add contaminants to the fuel.

Figure 30 Fuel filter assembly

1. Fuel primer pump
2. Fuel filter cover
3. Water drain valve (closed)
4. Fuel filter housing
5. Fuel strainer
6. Bleeder valve

1. Set the parking brake and shift the transmission to park or neutral.

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Service Procedures (cont.)

FUEL FILTER (cont.)

WARNING: To prevent personal injury or death, make sure that the engine has cool before removing components.

2. Turn ignition switch to OFF and allow engine to cool before removing components.

CAUTION: To prevent engine damage, clean area around fuel filter housing before removing fuel filter cover This will protect the open fuel filter housing from contaminants falling into the housing. If contaminants do fall in, remove them and blow out fuel filter housing with compressed air before installing a new filter element. Contaminants reaching high-pressure fuel system components may cause component failure.

3. Clean engine compartment components in the area of the fuel filter housing using compressed air, before removing the fuel filter cover. also, wipe the fuel filter cover clean to prevent contaminants from entering the fuel system. Contaminants may cause engine failure.
4. Loosen the fuel filter cover counterclockwise three and one-half turns to allow the fuel filter housing to vent.
5. Attach a hose to the end of the water drain valve.
6. Put a suitable container under the hose from the water drain valve.
7. Open water drain valve and drain the fuel filter assembly.
8. Close water drain valve.
9. Dispose of fuel in an approved container.

CAUTION: To prevent engine damage, do not remove or install the fuel filter element with the fuel filter cover attached; this will damage the stand pipe located inside the fuel filter housing. Do not remove or unplug the engine wiring harness connector located above the fuel filter housing.

Service Procedures (cont.)

FUEL FILTER (cont.)

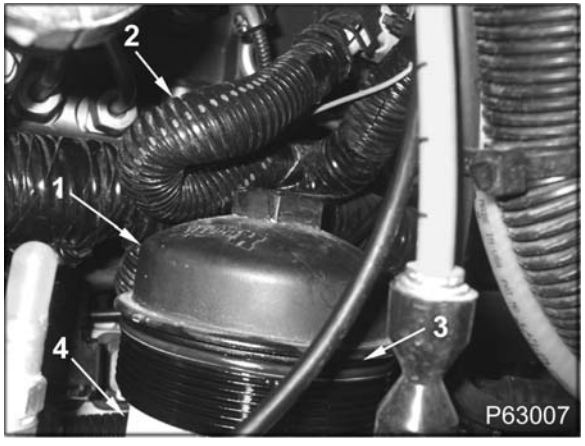

Figure 31 Fuel filter c0ver and element removal

1. Fuel filter cover
2. Engine wiring harness
3. O-ring (cover)
4. Fuel filter element

10. Push in or hold aside the engine wiring harness, located above the fuel filter cover, to allow more clearance when removing the fuel filter cover and element. Do not unplug the engine wiring harness connector.

CAUTION: To prevent engine damage, do not break the fuel filter stand pipe when removing the fuel filter element from the fuel filter housing. The fuel filter stand pipe is approximately one inch taller than the fuel filter housing.

11. Loosen the fuel filter cover. Once the fuel filter cover has been loosened from the fuel filter housing, lift the fuel filter cover and element half way out of the fuel filter housing.

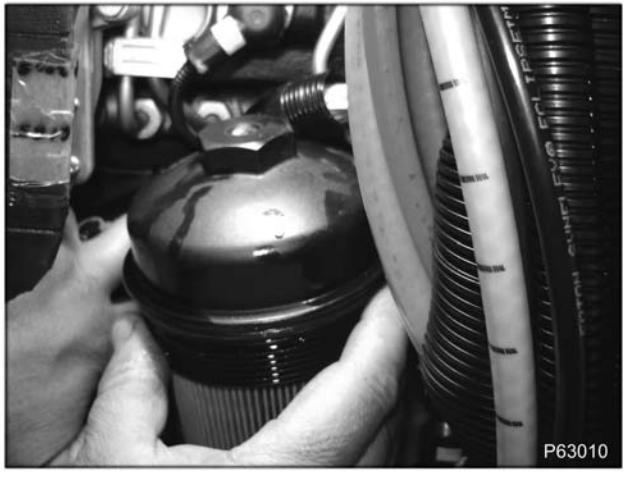

Figure 32 Fuel filter cover removal

Service Procedures (cont.)

FUEL FILTER (cont.)

12. Remove the fuel filter cover from fuel filter element by holding the element vertically and pushing up on the cover. The cover will snap off the fuel filter element.
13. Pull the fuel filter element straight up out of the fuel filter housing. This eliminates side pressure on the stand pipe. If the engine wiring harness is in the way of the fuel filter element, push lightly on the wiring harness for additional clearance. Do not unplug the engine wiring connector.
14. Remove the O-ring from the fuel filter cover.
15. Dispose of the fuel filter element and O-ring from the fuel filter cover according to applicable regulations.

CAUTION: To prevent engine damage, do not remove or install the fuel filter element with the fuel filter cover attached; this will damage the stand pipe that is located inside the fuel filter housing. Do not remove or unplug the engine wiring harness connector that is located above the fuel filter housing.

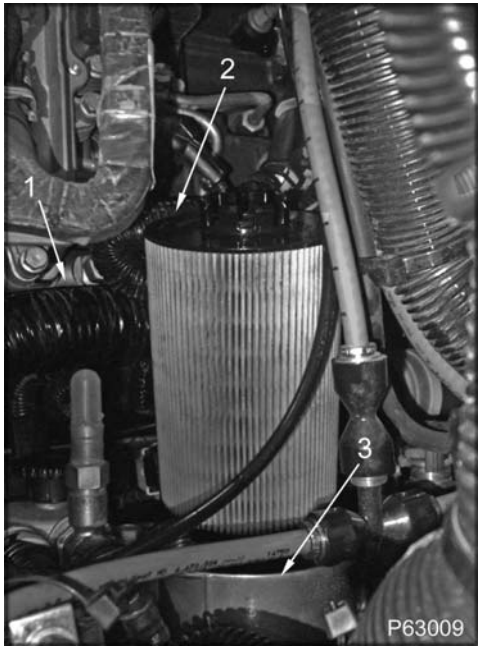

Figure 33 Fuel filter element removal and installation with cover removed

1. Engine wiring harness
2. Fuel filter element
3. Fuel filter housing

Service Procedures (cont.)

FUEL FILTER (cont.)

16. Coat a new O-ring for the fuel filter cover with clean diesel fuel and install onto the fuel filter cover.
17. Coat the threads of the fuel filter cover with clean diesel fuel. Set fuel filter cover aside for installation.
18. Push in or hold aside the wiring harness located above the fuel filter housing to allow more clearance when installing the fuel filter element.
19. Install the fuel filter element into the fuel filter housing. When the fuel filter element is inserted approximately half way into the fuel filter housing, hold the fuel filter element in this position and install the fuel filter cover onto the fuel filter element.
20. Secure the fuel filter cover onto the fuel filter element by pushing down on the fuel filter cover while holding onto the fuel filter element. The fuel filter cover will snap onto the fuel filter element.
21. Once the fuel filter cover has been installed to the fuel filter element, continue inserting the fuel filter element into the fuel filter housing.
22. Secure the fuel filter cover and element to the fuel filter housing by turning the fuel filter cover clockwise until finger-tight.

CAUTION: To prevent engine damage, tighten fuel cover on fuel filter assembly.

23. Tighten the fuel filter cover to 20 to 25 N·m (15 to 18 lbf·ft).
24. Prime the fuel system before starting the vehicle. See “Section 4 - Engine Operation, Priming the Fuel System” in this manual.

FUEL STRAINER

Service Interval: 80,000 km (50,000 miles), 24 months, 2,200 hours or 32,000 liters (8,400 gallons) of fuel.

NOTE: If fuel used has more than average impurities, shorter service intervals may be required.

WARNING: To prevent personal injury or death, do not smoke and keep fuel away from flames and sparks.

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Service Procedures (cont.)

FUEL STRAINER (cont.)

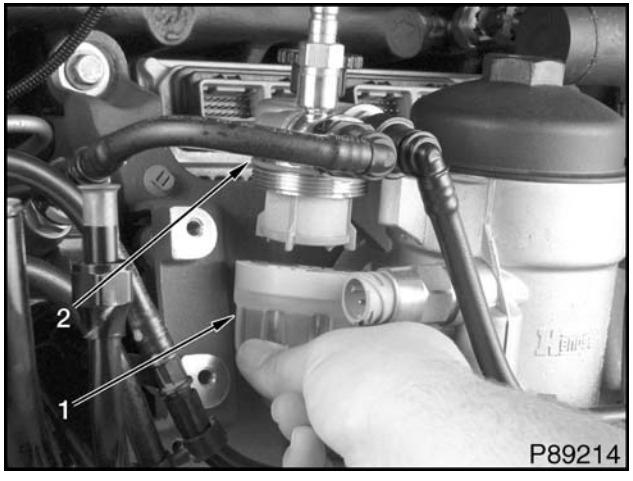

Figure 34 Fuel strainer cover

1. Fuel strainer cover
2. O-ring

1. Set parking brake and shift transmission to park or neutral.
2. Unscrew fuel strainer cover from fuel primer pump.
3. Remove and discard fuel strainer cover O-ring.

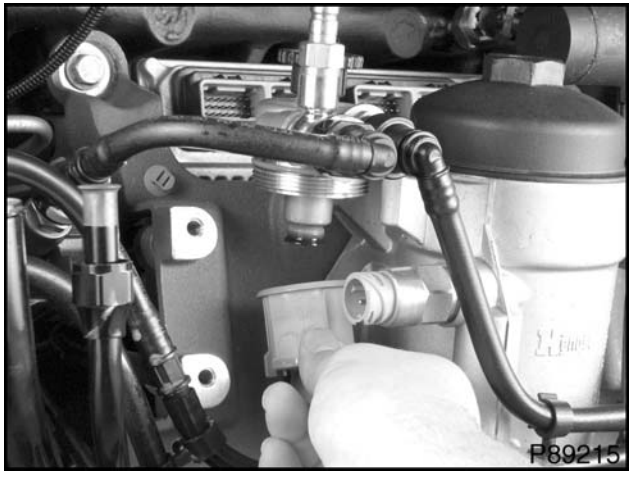

Figure 35 Fuel strainer

4. Remove fuel strainer.
5. Do one of the following:
   - If strainer is not damaged, clean the fuel strainer with clean diesel fuel.
   - If strainer is damaged, install a new fuel strainer.
6. Install a new fuel strainer cover O-ring.

Service Procedures (cont.)

FUEL STRAINER (cont.)

7. Coat threads and O-ring on fuel strainer cover with clean diesel fuel.
8. Install fuel strainer cover and tighten to 10 N·m (89 lbf·in).
9. Prime fuel system.

ELECTRICAL SYSTEM

Service Interval: Annually

1. Check wiring harness for cracks, rubbing, and loose connections.
2. Check sensors for loose connections, corrosion or cracks.
3. Check battery cables for the following conditions:
   - Broken insulation.
   - Rubbing or chaffing.
   - Corroded or loose connections.

Electronics

Check for fault codes and repair as required. After repairs are made, clear fault codes and verify they do not reappear. For correct procedures, see the International® MaxxForce® 11 and 13 *Engine Diagnostic Manual* or contact your International® dealer.

Service Procedures (cont.)

SERVICE BREATHER ELEMENT

Service Interval: 161,000 km (100,000 miles)

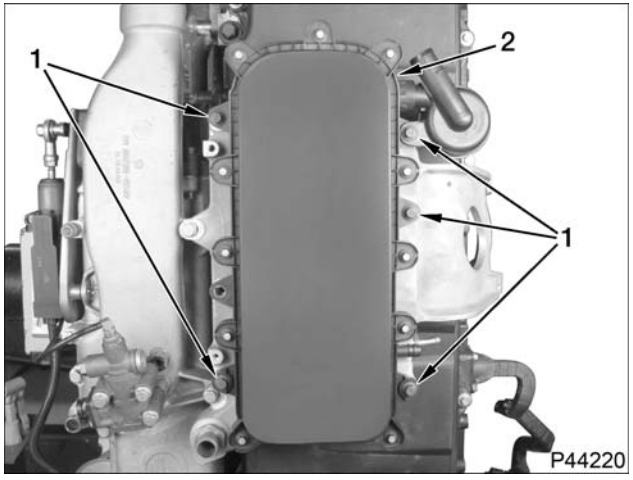

Figure 36 Service breather assembly (breather insulator removed)

1. M8 x 35 hex bolt
2. Service breather cover

1. Set parking brake and shift transmission to park or neutral.
2. Remove breather insulator from service breather.
3. Remove five M8 x 35 hex bolts securing service breather cover.
4. Remove service breather cover and discard service breather element according to local regulations.
5. Install new service breather element.
6. Place service breather cover over service breather element.
7. Secure service breather cover with five M8 x 35 hex bolts. Tighten hex bolts to 31 N·m (23 lbf·ft).
8. Install breather insulator onto service breather.

CLEAN AFTERTREATMENT FUEL INJECTOR

Service Interval: 161,000 km (100,000 miles), 3,000 hours

For cleaning procedures, see the International® MaxxForce® 11 and 13 *Engine Service Manual* or take vehicle to your International® dealer for cleaning.

ENGINE VALVE LASH

Service Interval: 400,000 km (250,000 miles)

For adjustment procedures, see the International® MaxxForce® 11 and 13 *Engine Service Manual* or take vehicle to your International® dealer for adjustment.

Service Procedures (cont.)

ENGINE RETARDER LASH (IF EQUIPPED)

Service Interval: 400,000 km (250,000 miles)

For adjustment procedures, see the International® MaxxForce® 11 and 13 *Engine Service Manual* or take vehicle to your International® dealer for adjustment.

CLEAN DIESEL PARTICULATE FILTER

For Engines Using CJ-4 Engine Oil

Service Interval: 400,000 km (250,000 miles) 30 months or 6,000 hours

Clean DPF at designated service interval. Take vehicle to your International® dealer for cleaning.

For Engines Using CI-4 Engine Oil

Service Interval: 322,000 km (200,000 miles) 22 months or 4,500 hours

Clean DPF at designated service interval. Take vehicle to your International® dealer for cleaning.

EXTENDED LIFE COOLANT (ELC) EXTENDER

Service Interval: 500,000 km (300,000 miles), 3 years, or 6,000 hours

NOTE: The International® ProStar® and TransStar® vehicles are equipped with both a deaeration tank and an expansion tank. Never add ELC to the expansion tank. Only add ELC to the deaeration tank per the following procedure.

Service Procedures (cont.)

EXTENDED LIFE COOLANT (ELC) EXTENDER (cont.)

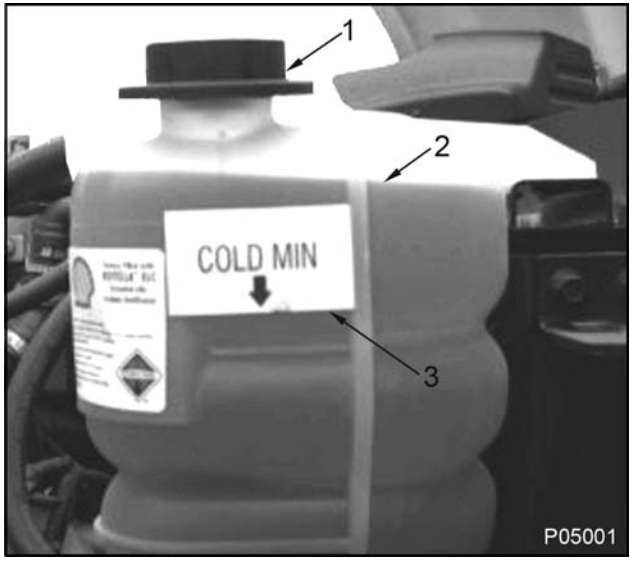

Figure 37 Deaeration tank (typical)

1. Non-vented deaeration tank cap
2. MAX coolant level
3. COLD MIN coolant level

⚠ WARNING: To prevent personal injury or death, do the following when removing the radiator cap or deaeration cap:

- Allow the engine to cool for 15 minutes or more.
- Wrap a thick cloth around the radiator cap or deaeration cap.
- Loosen the cap slowly a quarter to half turn to vent pressure.
- Pause for a moment until all pressure has escaped to avoid being scalded by steam.
- Continue to turn the cap counterclockwise to remove.

1. Remove the non-vented deaeration tank cap.

ROTELLA® ELC Extender

Cooling System Capacity	Drain ELC Coolant	Add ROTELLA® ELC Extender
22-30 liters (6-8 gallons)	0.2 liter (0.5 quart US)	0.2 liter (0.5 quart US)
30-49 liters (8-13 gallons)	0.5 liter (1.0 quart US)	0.5 liter (1.0 quart US)
49-83 liters (13-22 gallons)	0.7 liter (1.5 quart US)	0.7 liter (1.5 quart US)

Service Procedures (cont.)

EXTENDED LIFE COOLANT (ELC) EXTENDER (cont.)

2. Confirm coolant system capacity.
3. According to cooling system capacity in the ROTELLA® ELC Extender table, drain the correct volume of coolant from the cooling system.

NOTE: Shell ROTELLA® ELC 50/50 Premix is the standard factory fill for the cooling system. ROTELLA® ELC 50/50 Premix is used to replenish coolant loss and ensure that glycol/water concentrations stay in balance. If a customer wishes to use a different coolant, it should minimally meet ASTM D6210, Standard Specification for fully - Formulated Glycol Base Engine Coolant for Heavy Duty Engines.

4. Add the same volume of ROTELLA® ELC Extender to the cooling system.
5. Check coolant level. If necessary, add ROTELLA® ELC 50/50 Premix to bring coolant level to the top of the deaeration tank (MAX level).
6. Install and tighten the non-venting deaeration tank cap.

SERVICE COOLING SYSTEM

Service Interval: 1,100,000 km (600,000 miles), 6 years, or 12,000 hours

See vehicle Service Publications or your International® dealer for cooling system drain and refill procedure.

WARNING: To prevent personal injury or death, make sure the engine has cooled before draining coolant.

CAUTION: To prevent engine damage, engine coolant drain and refill procedure must be followed per the instructions in the vehicle Service Publications or as supplied by your International® dealer.

ESTIMATED REPLACEMENT OF DIESEL PARTICULATE FILTER

Service Interval: 1,930,000 km (1,200,000 miles)

Replace diesel particulate filter.

NOTE: See vehicle *Operator's Manual* for service and maintenance procedures for DPF.

Maintenance Service Record

WARNING: To prevent personal injury or death, read all safety instructions in the "Safety Information" section of this manual.

WARNING: To prevent personal injury or death, shift transmission to park or neutral, set parking brake, and block wheels before doing diagnostic or service procedures.

Save scheduled maintenance work orders and receipts for proof of correct maintenance. Failure to maintain work orders and receipts may affect your warranty coverage.

Maintenance Service Record (cont.)

Maintenance Service Record

Date	Service Month	Service Hours	km (Miles)	Item Serviced

Maintenance Service Record (cont.)

Maintenance Service Record

Date	Service Month	Service Hours	km (Miles)	Item Serviced

Daily Care and Report

WARNING: To prevent personal injury or death, read all safety instructions in the "Safety Information" section of this manual.

WARNING: To prevent personal injury or death, put transmission in neutral or park, set parking brake, and block wheels before doing diagnostic or service procedures.

Check the following daily to prevent engine failure. Report all problems for immediate service.

- Oil level.
- Oil, air, fuel or coolant leaks.
- Correct coolant and coolant system level
- Excessive consumption of crankcase lubricating oil, coolant or fuel.
- Unusual engine noise.

Do the following daily to prevent engine failure.

- Add coolant if necessary. Make sure filler cap seal is in good condition and the cap is installed tightly.
- Check the air filter element restriction gauge. When the yellow position indicator reaches and locks in the red zone, a new air filter should be installed.
- Fill the fuel tank with correct fuel.
- Inspect external surfaces of the engine, around and between the radiators, and accessories. Clean as necessary.

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Daily Care and Report (cont.)

Daily Care and Report

Model									
Serial No.									
Date	Miles	Fuel		Lube Oil	Parts		Labor		Service Performed
		Qty	Cost		Parts	Cost	Time	Cost	

Daily Care and Report (cont.)

Daily Care and Report

Model									
Serial No.									
Date	Miles	Fuel		Lube Oil	Parts		Labor		Service Performed
		Qty	Cost		Parts	Cost	Time	Cost	

CALIFORNIA

Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects and other reproductive harm.